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BIG CREEK FLOOD CONTROL PROJECT, CLEVELAND, OHIO. PHASE II. GEN--ETC(U)
AUG 79

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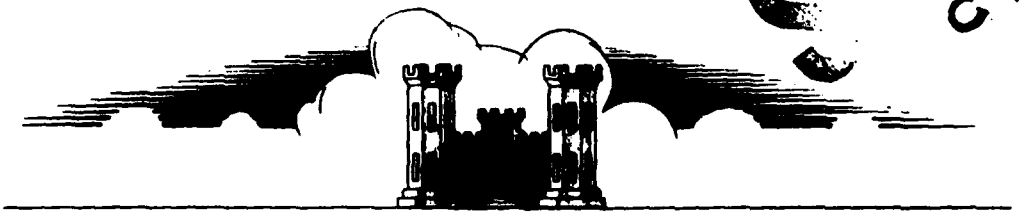
BIG CREEK FLOOD CONTROL PROJECT

CLEVELAND, OHIO

PHASE II

GENERAL DESIGN MEMORANDUM



Prepared by
GANNETT FLEMING CORDDRY AND CARPENTER, INC.
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For
U.S. ARMY ENGINEER DISTRICT, BUFFALO
Corps of Engineers
Buffalo, New York 14207

AUGUST 1979

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
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Flood Control
Big Creek

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)
The Big Creek Watershed is located in northeastern Ohio, wholly within Cuyahoga County. The watershed is roughly triangular in shape with a total drainage area of 37.6 square miles. The flood control project is within the city of Cleveland and extends from approximately one mile upstream of the Creek's confluence with the Cuyahoga River, upstream into Brookside Park, approximately 2.3 miles from the confluence. Presently, all life, property, and industry within the flood plain described above is subject to flood damage. The project is based on the need to protect these resources agaainst present and

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projected flood damage as required by Section 108 of Public Law 91-611. The project is designed to prevent flood damages from an event having a 1 percent probability of occurrence (12,000 cfs) within the project area. The protection to be provided meets the Naitonal Flood Insurance Program requriements for new development and th Corps policy for human health and safety, property, and industry protection. The plan involves 2,700 LF of floodway channel with a design discharge capacity of 6,000 cfs; 1,860 lf of modified channel of 12,000 cfs, and a 1,000 LF diversion channel with a design discharge capacity of 7,000 cfs. Associated with the flood control plan is the relocation of the Baltimore and Ohio (B & 00 mainline (4,720 LF) and a spurline (1,030 LF). The railroad relocation requires the construction of two new permanent railroad bridges for the B & O and a temporary trestle to facilitate construction for the Norfold and Western (N & W) Railway.

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

PHASE II
GENERAL DESIGN MEMORANDUM

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ADDITIONAL COMMENTS ON THE PHASE II GDM

1. The "Clarification Statement" has recently been re-designated a "Supplement Information Report" (ref. ER 200-2-2). This report does not reflect this recent terminology change although the current "Supplemental Information Report" is included (pages A29 thru A37).

2. The Supplemental Information Report enclosed in this report is currently being revised to address the following comments:

a. Para. 3.02 should address the impacts (briefly identified in the Phase II GDM, para. 63, pgs. 23-24) since the earlier FEIS did not plan to transport the unsuitable excavated material to Gardner Flats. Measures to reduce these social impacts should also be identified.

b. The SIR must address the borrow areas and discuss the impacts if the current FEIS does not.

c. The information presented is not adequate to support the conclusion that "The use of Gardner Flats as a disposal site for the Big Creek Flood Control Project is in compliance with EP 11988" (para. 3.03). As a minimum, the following information must be provided.

(1) The 100-year flood plain limits on and adjacent to the proposed disposal site should be developed.

(2) The impacts that the disposed material would have on flood elevations at the site and upstream and downstream of the site should be determined and discussed.

(3) The use of the flood plain as a disposal site must meet the flood plain management standards established by the State of Ohio. A statement to this effect must be provided.

(4) Alternative non-floodplain disposal sites must be considered and information must be provided on the practicability of the non-flood plain sites. The flood plain site can be used only if the non-flood plain sites are not practicable (see para. 7 of ER 1165-2-26).

d. Para. 3.03 states that section 404(r) is not applicable to the Gardner Flats site. No information however, is provided concerning the runoff of the residual water after transportation, if the disposal site is lined to prevent groundwater seepage, or the exact location of the disposal area. In addition, it is not established that the "much needed feeding station on the site for migratory birds" is dependent upon the project. Environmental enhancement may well be viable without Corps use of the site.

e. It is not stated in the report that the District will comply with each of the conditions set forth by the Ohio EPA in its section 401 Certiciate.

3. The term "Soil Area" used in this report will be replaced by the term "Disposal Area" in the contract documents.

4. In response to the enclosed 4 April 1979 letter from the U.S. Fish and Wildlife Service (USF&WL) the Buffalo District will forward a copy of the construction contract plans and specifications to the USF&WL for review and further comment.

5. Utility relocation agreements are being negotiated between the Buffalo District and the affected utility companies noted in the report. The utility companies are being requested to design, prepare plans and specifications and relocate the affected utilities at Federal expense.

6. The "Contract for Relocation and Alteration of Facilities" contained in this report is currently being revised by the railroads involved.

NCBED-DM (6 Apr 79) 2nd Ind
SUBJECT: Phase II GDM for Big Creek Flood Control Project, Milestone 42

DA, Buffalo District, CE, Buffalo, New York 14207 10 August 1979

TO: Division Engineer, North Central
ATTN: NCDED-T

1. Attached are 3 revised copies of the Phase II GDM for your review and approval. This revised Phase II GDM report incorporates your 1st Ind (6 Apr) comments 2, 3, 4, 8, 9, 12c, and 13d.

2. Comments 1, 10c(2), and 14 are noted. A response is not required.

3. The remaining comments: 5, 6, 7, 10a, 10b, 10c(1), 10(d), 10f(13a), 10e, 10g(13b), 11, 12(a), 12(b), 13c and 13e are individually discussed below:

a. Comment 5. A table showing the authorizing document cost estimate (Phase I approved estimate) and the current estimated cost with appropriate explanation of changes is contained in the Post Authorization Change Summary Report. This report was submitted to NCD on 11 July 1979 and is considered part of the Phase II GDM report.

b. Comment 6. Real Estate costs shown in the Phase I GDM were based on a review of tax assessments and an economic analysis of some 44 land sales in and around the project area and all within the City of Cleveland.

Within the past year, the sponsor has acquired 3 parcels of land within the project area ranging from 1/3 of an acre to 3¼ acres and paid a price range of $1665 per acre to $4464 per acre or an average price of $3556 per acre. Sponsor feels that our current estimate of $934,000 is reasonable and sufficient for land acquisition.

c. Comment 7. This project involves only about 46½ acres of vacant land in six ownerships. No residential or business relocations will result from the project.

d. Comment 10(a) is discussed in Section V of the main report.

e. Comment 10(b). From the subsurface data obtained, the material appears to be a weathered shale. The foundation design used a loading of 2 kips/SF which appears conservative for this soil.

f. Comment 10c(1). The testing laboratory was approved by NCD, letter dated 25 April 1978.

g. Comment 10 (d), is responded to in Sub Appendix D-3 of the Design Analysis.

NCBED-DR (6 Apr) 2nd Ind
SUBJECT: Phase II GDM for Big Creek Flood Control Project, Milestone 42

h. Comment 10(e). Laboratory tests have not yet been received for the borrow material to be used. Upon receipt of these tests, [illegible]zonation within the embankment will be considered and incorporated into the contract documents if appropriate.

i. Comment 10f(13b). We concur that it would be difficult for the sudden drawdown case to develop and do not have the computations to verify its existance. The AE elected (and we concurred) to use conservative design assumptions along the floodway and diversion channels because of the consequences of failure. The conservative design assumptions provides an additional degree of confidence in the project design where failure could be considered catastrophic.

j j. Comment 10g(13a). Per your request, Section II will be forwarded to you for review before the projects' plans and specifications are submitted for approval.

k. Comment 11. The three-foot clay blanket was deemed necessary to cover the projecting debris along the slope after it is shaped. Site investigations have revealed various large and bulky items buried in the trash pile (car parts, large posts, ...) which must be covered. The AE and Buffalo District agreed that 12 inches of cover did not seem adequate. Clay was used as an environmental measure to minimize polluted leachate, if any, from flowing down the embankment.

l. Comment 12(a). The freeboard on the chute will be revised in accordance with EM1110-2-1603. The revisions will be incorporated on the contract plans.

m. Comment 12(b). Critical flow depths exist at all drops. The flow profiles next to these drops resemble the profiles near constricted flow openings. The flow profiles reach normal depth a short distance from the drop and were plotted from the back-water computation results. The scale on page C-15 is such that the profiles appear to be straight lines. Further, there is no significant effect of the water surface elevation near these drops based on the area around the floodway.

n. Comment 13c. Is addressed in paragraph D15 and D29 of the Design Analysis. The foundations will be placed on rock. Limited excavation will be performed as required.

o. Comment 13e. The computer programs used in the appendix for slope stability have been verified by long hand computations as outlined in EM1110-2-1902 and are shown on plates D-4-8 and D-4-9 of Appendix D. The railroad alignment and geometry programs were not verified. However, several spirals and curves were verified using an HP 97 desk calculator.

ps2225

NCBED-DM (6 Apr 79) 2nd Ind
SUBJECT: Phase II GDM for Big Creek Flood Control Project, Milestone 42

4. The Clarification Statement to the Final Environmental Statement, Big Creek Flood Protection Project, Cleveland, Ohio has been revised to address the comments provided by NCDPD-ER's (26 February 1979) 1st Ind letter. Five copies of the revised clarification statement are enclosed for your review and processing.

Incl
as

GEORGE P. JOHNSON
Colonel, Corps of Engineers
District Engineer

NCDED-T (6 Apr 79) 1st Ind
SUBJECT: Phase II GDM for Big Creek Flood Control Project, Milestone 42

DA, North Central Division, Corps of Engineers, 536 South Clark Street, Chicago, Illinois 60605 11 MAY 1979

TO: District Engineer, Buffalo

1. Subject Phase II is concurred in subject to the following comments.

2. Benefit/cost ratio is low, therefore, verification of the estimated cost is of major importance.

3. Page 2. Add to the items of local cooperation. Provide without cost to the United States all lands, easements, rights-of-way and disposal areas necessary for construction and subsequent maintenance of the project.

4. Change items a, b, c, and d to b, c, d, and e, respectively.

a. Revise item b to read as follows: "... hold and save the United States free from all claims for damage incident to construction and subsequent maintenance of the project, except damage due to the fault or negligence of the Government or its contractors."

b. Item c should read: "prescribe and enforce regulations . . ."

c. Add item f as follows: "f. Comply with the applicable provisions of the "Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970," Public Law 91-646, approved 2 January 1971, in acquiring lands, easements, rights-of-way and disposal areas for construction and subsequent maintenance of the project."

5. A table showing the authorizing document cost estimate, the latest PB-3A, and the current estimated cost with appropriate explanation of changes should be shown.

6. Page 42, paragraph 81. The estimate of land cost was not prepared by NCDRE-E. Consumer Price Indices is not utilized by professional appraisers. The validity of the estimate is unknown. In referring to the factor of increase of 1.17, Farmland Price Values are included while on page 60, the Consumer Price Index alone shows an increase of 1.17. Also, from Oct 76 to Jan 79 the Consumer Price Index increased 18.1% and, at least a 49% increase in farmland prices.

7. Pages 43, 62, 65, E3 and E18. No gross appraisal was prepared on which these valuations were based as required by paragraph 5 of EP 405-1-2. We do not have sufficient information to judge the adequacy of the property acqusition costs, such as number of tracts, number of ownerships, number and type of dislocations requiring relocation assistance.

8. Page 44, para. 84. There is no authorizing document. Section 108a of PL 91-611 requires that non-Federal public interests shall agree to such items of local cooperation as the Secretary of Army deems appropriate "except that such conditions shall be similar to those required for similar project purposes in other Federal Water Resources Projects."

9. Page 67. Recommendations need to be completed. The recommendation should be conditioned on non-Federal interests entering into an agreement pursuant to Section 221 of PL 91-611 containing the items of local cooperation on page 2 (as revised herein).

10. Appendix A:

a. Page A-5, para. A-12. The on-site geology inspection doesn't mention stability. The outcrops and general area should have been studied for slump topography and other signs of instability. Expound briefly on this subject.

b. Page A-8, para. A-26. This highly plastic clay could be a significant feature with regard to stability. Discuss this material and areas of occurrence as it relates to stability.

c. Page A-11, para. A-33:

(1) Verify that the testing laboratory was approved by ORD. See OCE letter, dated 5 March 1976.

(2) The testing program appears to be overelaborate for a project of this type and scope, i.e., consolidation tests, R and S triaxial tests, permeability and hydraulic pressure tests all could have probably been assumed for a project of this size. The District should control the A&E more closely on this matter as well as on the amount of analysis necessary.

d. Page A-20, para. A-72.1.2. Show that bedding material will not pass through riprap by the $\frac{D15}{D85}$ relationship.

e. Page A-25, para. A-74.8. It is agreed that lowering the water content of the excavated material will be difficult. It is recommended that borrow be used for the more critical railroad embankment and the

higher water content material be placed in areas where strength is not as important. Suggested areas would be for sealing the dump, for fill material in low height levees (less than 8 feet) and earthfill to protect air-slaking shale.

f. Page A-24, para. A-78. It is difficult to see that the sudden drawdown case could develop. Show by computations using permeabilities and flood stage duration time that this is a viable case.

g. Page A-28, Section H. This portion of the report along with related stability analyses should be presented for review before submittal of plans and specifications.

11. Appendix B. Page B-46, para. B-121 and page A-18, para. A-64. Give justification for the 3 foot clay blanket. Twelve inches of topsoil and seeding should suffice for sealing the exposed slope.

12. Appendix C.

a. Plate 10. The freeboard on the chute should be provided in accordance with EM 1110-2-1603. The EM requires a freeboard equal to 2 feet plus 2.5% of the product between mean depth and velocity.

b. Plate C-15. The water surface profile along the "A" Diversion is unrealistic. The correct computer profile should be plotted and should approximate an M-2 profile since the control is near the drop for each step and the water surface appears to approach normal depth in the upstream direction in a channel having a mild slope.

c. Explain in the text of the hydraulics appendix how the magnitude of flows through the different diversions were determined.

13. Appendix D.

a. Page D-22, para. D-73. See comment 10g.

b. Page D-24, para. D-46. See comment 10f.

c. Page D-20. Discuss foundations conditions, particularly bridge foundations, and present recommendations for each structure.

d. Page D2-22. Present the method used for determination of the location of the maximum deflection computed.

e. Have the computer programs used in this appendix been verified? If so, how?

NCDED-T
SUBJECT: Phase II GDM for Big Creek Flood Control Project, Milestone 42

14. In general, this is a well written report. The District is commended for the excellent presentation.

FOR THE DIVISION ENGINEER:

wd incl

LEE R. HOGLIND
Acting Chief, Engineering Division

DEPARTMENT OF THE ARMY
BUFFALO DISTRICT, CORPS OF ENGINEERS
1776 NIAGARA STREET
BUFFALO, NEW YORK 14207

NCBED-DM

6 April 1979

SUBJECT: Phase II GDM for Big Creek Flood Control Project, Milestone 42

Division Engineer, North Central
ATTN: NCDED-T

1. Enclosed are six (6) copies of the Phase II GDM Summary Report for your review and approval.

2. Submission of these reports completes the Milestone 42 requirements for the Big Creek Flood Control Project. The reports are being submitted as agreed upon (FONECON 6 Feb 79) between your Mr. Snowden and my Project Manager, George Brooks.

3. It is noted that the Phase II GDM cost estimate reflects a very substantial increase in cost compared to the latest approved estimate. This increase is presently being analysed and the analysis will be submitted as a revision to Section XV Cost Estimates to quantify detailed changes between the Phase I and Phase II GDM's.

DANIEL D. LUDWIG
Colonel, Corps of Engineers
District Engineer

6 Incl.
as

SUMMARY REPORT
POST AUTHORIZATION CHANGE
BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

1. Purpose of Report. Approval of the Chief of Engineers is required (ER 1105-2-31) for authorized projects which undergo significant changes. Such a post-authorization change (PAC) has occurred in the Big Creek Flood Control Project as the total project cost has increased more than 25 percent over the estimate last presented to Congress. The project costs (Table 3) have increased from $5,543,000 (October 1978 price level) to $13,465,000 (October 1979 price levels), a total increase of 143 percent.

The purpose of the project, the project benefits, and the project scope have not changed from that previously presented to Congress. This report discusses the significant project cost increase presented in the Phase II GDM report.

2. Description of Authorized Project

a. Location. The Big Creek Watershed is located in northeastern Ohio, wholly within Cuyahoga County. The watershed is roughly triangular in shape with a total drainage area of 37.6 square miles. The flood control project is within the city of Cleveland, and extends from approximately one mile upstream of the creek's confluence with the Cuyahoga River, upstream into Brookside Park, approximately 2.3 miles from the confluence.

b. Function. Presently, all life, property, and industry within the flood plain described above is subject to flood damage. The project is based on the need to protect these resources against present and projected flood damage as required by Section 108 of Public Law 91-611. The project is designed to prevent flood damages from an event having a one percent probability of occurrence (12,000 cfs) within the project area. The protection to be provided meets the National Flood Insurance Program requirements for new development and the Corps policy for human health and safety, property, and industry protection.

c. Plan of Improvement for Authorized Project. The plan involves 2,700 LF of floodway channel with a design discharge capacity of 6,000 cfs; 1,860 LF of modified channel of 12,000 cfs, and a 1,000 LF diversion channel with a design discharge capacity of 7,000 cfs. Associated with the flood control plan is the relocation of the Baltimore and Ohio (B&O) mainline (4,720 LF) and spurline (1,030 LF). The railroad relocation requires the construction of two new permanent railroad bridges for the B&O and a temporary trestle to facilitate construction for the Norfolk and Western (N&W) railway.

d. Local Cooperation. Prior to construction, responsible local interests must give assurances satisfactory to the Secretary of the Army that, in accordance with Section 108 of Public Law 91-611, they agree to such conditions of local cooperation as the Secretary of the Army, acting through the Chief of Engineers, determines appropriate except such conditions shall be similar to those required for similar project purposes in other Federal water resources projects. The local interests are required to: provide all lands, easements, rights-of-way, and utility and highway relocations; hold and save the Government free from damages due to the construction, and assume the operation and maintenance of the project after construction.

3. Authorization. The authorization for the flood protection project in the Big Creek Watershed is derived from Section 108 of Public Law 91-611 passed on 31 December 1970. In September 1971, the "Cuyahoga River Basin, Ohio, Restoration Study - First Interim Report" was completed under this authorization. The interim report included a "Reconnaissance Level" study which recommended flood protection in the Big Creek Watershed in the vicinity of the Cleveland Zoo. By letter, dated 25 September 1975, the Assistant Secretary of the Army exercised his authority to implement the plan for construction. As the project was authorized based on a reconnaissance level study, a project feasibility "survey level" study was required. The Phase I GDM served this function. The Phase II study has modified, reaffirmed, and designed the authorized project based upon the detailed engineering data gathered during the study and the changed site conditions observed.

4. Funding Since Authorization. The following table provides a history of project AE&D funding for the Big Creek Flood Control Project:

Table 1 - Project Funding History

Fiscal Year	Funds Appropriated ($000)	Funds Transferred ($000)	Accumulated Funds Received ($000)
FY 75	0	0	0
FY 76	200.0 1/	-20.0	180.0
FY 77	250.0	0	430.0
FY 78	90.0	+100.0	620.0
FY 79	250.0	0	870.0

1/ Funds appropriated during FY 73 and FY 74, but withheld by OCE until FY 76.

5. Changes in Scale and Scope of Authorized Project. The selected plan of improvement presented in the Phase I GDM (Nov 1977) does not differ from the project design presented in the Phase II GDM (Mar 1979) in scale or scope. The cost change noted is due to design changes, increased unit price values, and changed conditions experienced in the project area.

6. Changes in Project Purpose. The project purpose remains unchanged from the approved Phase I GDM report.

7. Changes in Local Cooperation Requirements. The items of local cooperation presented in the approved Phase I GDM report remain unchanged. The costs of local cooperation have increased to account for the utility relocations not previously anticipated and the increase in land easements required to complete the construction.

8. Changes in Location of Project. The project location remains unchanged. The increase in land easements required for the project is a result of including: public owned lands in the area (Metropolitan and the city of Cleveland); temporary work areas not previously anticipated; and additional lands required to complete the spurline trackage relocation not identified in the Phase I GDM report.

9. Design Changes. Generally, the increase in project cost is due to changed project conditions, changes in project features and design refinements, and changes in unit costs and price levels. A comparison of the Phase I and Phase II estimate is shown in Table 2. The following is a discussion of the significant cost changes between the Phase I and Phase II GDM project estimates as a result of changed conditions and/or design requirements as follows.

a. Cost increases due to changed conditions:

i. Excavation (+$35,000 due to price level increase and +$1,176,000 due to changed conditions). The Phase I GDM estimate was based on field reconnaissance trips in the area and the available 1960 USGS topographic maps with 10-foot contours. During the Phase II study, updated topographic maps were obtained (Aug 1977) and utilized in preparing the revised estimate. The updated maps revealed significant topographic changes in the downstream portion of the project where a large trash pile is now located. The trash pile increased the common excavation by roughly 150,000 cubic yards. The channel profile realignment (discussed below) accounts for the addition excavation quantities of common excavation noted in Table 2.

ii. Spoil (+$605,000 change due to changed conditions). During the Phase I study, the material required for the levee and landfill areas was assumed to be available at the project site from the

excavations required. The subsurface investigation and testing program conducted during the Phase II study revealed that none of the excavated material would be suitable for the construction use considered and consequently must be disposed of (ref. Appendix A, Phase II GDM). The quantity of spoil further increased as the trash pile at the downstream end of the project area noticeably increased since the Phase I study was accomplished. The nearest acceptable spoil area found is approximately 13 miles from the project area.

iii. Rock Excavation (+$34,000 due to price level increase; +$405,000 due to changed conditions). No subsurface explorations were made in the project area during the Phase I GDM study. The Phase II GDM subsurface exploration program revealed that the rock in the area was an air slaking shale that could not be left exposed as previously planned. Protecting the shale from deterioration required over excavating (approximately 50,000 yards) portions of the floodway and main channel and covering it with a more stable material or applying shotcrete to the exposed surface (i..e., in the vicinity of the W. 25th Street Bridge).

iv. Utilities (+$1,000,000 due to changed conditions). During the Phase I GDM study, locals were contacted regarding utilities in the project area that would require relocation. None were identified. As the Phase II study progressed, numerous utilities were found to be in the project area that now require being relocated before the project can be completed. These utilities included a Cleveland Electric Illuminating (CEI) power pole, 15 KV underground electric line and duct bank, various sanitary and storm sewer lines, and an 8- and 20-inch water supply line.

b. Cost increases due to design changes:

i. Channel Profile. The Phase II GDM subsurface exploration program established the location of top of rock in the project area. The channel profile was realigned based on the rock profile to eliminate the vertical 8.5-foot concrete drop structures and replace them with five smaller sloping riprap drop structures (3 to 3.5-foot vertical drops). Although this change is more environmentally and aesthetically acceptable, the changed channel profile increased the total excavation required. Additionally, in response to comments on the projects EIS, a low-flow channel is incorporated into the modified channel. This low-flow channel is excavated in rock in the bottom of the modified channel. As the amount of material to be excavated increased, the amount of material required for spoil increased accordingly.

ii. Railroad Changes (+$68,000 increase due to price levels; +$2,067,000 increase due to design change). The mainline of the

Baltimore and Ohio Railroad was assumed to parallel the Norfolk and Western Railroad during the Phase I GDM to decrease the embankment material required and provide the maximum area possible for the floodway channel. The Phase II GDM study revealed that this alignment could not be maintained as current railroad construction standards (AREA) have changed since the N&W's construction. The new alignment required smaller degrees of curvature and spirals into and out of the curves required. These changes forced the railroads farther apart, increased the embankment material (borrow) required and increased the total trackage required. During the Phase I GDM study, the railroad embankment material was considered available from proposed project excavation as the existing B&O embankment material was obtained from the area. However, the material available was found unsuitable for this use under present design criteria and consequently, the material in the project area must be disposed of and additional borrow material brought in. The additional cost for the embankment material required (110,000 cubic yards) for the track relocation is approximately $1,040,000. The realignment increased the trackage required by 400 LF ($66,000). The track relocation unit price increase raised the estimate by $340,000.

The Phase I GDM spurline alignment was considered to be compatible with the overall project design requiring only a nominal amount of new trackage and a new single span (80-foot) railroad bridge. During the Phase II study, the diversion channel was realigned to take full advantage of the area available between the bridge piers to insure the project would function properly. This realignment caused the spurline bridge to approximately parallel the diversion channel instead of crossing it at a larger angle. Consequently, the railroad bridge required at this location was found not practical. Subsequently, an alternate spurline alignment and bridge location was developed. The spurline trackage required increased by approximately 1,000 LF ($166,000) and the bridge span doubled requiring two 76-foot spans and center pier ($208,000 increase). The special (No. 8) turnouts required for the new alignment also increased the cost by about $47,000. The remaining design cost increases ($200,000) are noted in Table 2 (road repairs, trestle, and B&O replacement bridge).

iii. Bridge Support (+$110,000 increase due to design change). The base of the W. 25th Street Bridge pier was considered to be below the diversion channel during the Phase I GDM study. However, as additional information became available, it was found that the bottom of the diversion channel would be below the pier. Consequently, a support system was incorporated into the project design to insure the pier would not be affected by the construction involved. The cost of this support system is estimated at $110,000.

iv. Concrete (+$45,000 due to price level increase; +$1,691,000 due to design changes). The concrete structures (chute, diversion

channel) were evaluated in the Phase I GDM based on similar structures constructed in other locations, but without considering the actual forces involved. The Phase II GDM study found that the sections required were considerably more substantial than those previously contemplated. Engineering decisions with regard to uplift forces, efficiency of underdrain systems, surcharge loads, and loading conditions greatly affected ultimate design accepted.

10. Changes in Total Project Costs. Table 3 is the "Project Cost Estimate (PB-3)," dated 1 May 1979, and shows a comparison between the project cost estimate last presented to Congress and the updated project costs (Oct 1979 price levels). The construction cost estimate cost differences are further clarified in Table 2. The Federal project cost increases are summarized as follows:

a. The project cost increase due to the design changes discussed in paragraph 9(a) through (b) account for $6,884,000 of the total Federal cost increase.

b. Price level increases account for the remaining $298,000 difference in total Federal cost increase noted in Table 3. Price escalation of construction features is $276,000 with the remaining $22,000 price level increase resulting from S&A.

11. Changes in Project Benefits. The project benefits were updated by price levels in the Phase II GDM study. The benefits were not otherwise reevaluated or increased.

12. Benefits Cost Ratio. Table 4 shows a comparison of B/C ratios for the Phase I and Phase II GDM reports. The project benefit categories presented in the Phase I GDM were: Flood Damage Reduction, Land Use Intensification, and Area Redevelopment.

Table 4 - Benefit Cost Data

	Phase I GDM (Oct 1978 Price Levels)	Phase II GDM (Oct 1979 Price Levels)
	$	$
Annual Project Costs	331,300	830,200
Annual Project Benefits	832,000	973,700
Benefit Cost Ratio	2.5	1.17
Percent Interest Rate	5-3/8	5-3/8

These benefits were not reevaluated during the Phase II GDM study. Although additional "future" benefits were considered applicable to the project during the Phase I, they were neither evaluated nor included in the study. The increase in benefits noted in Table 4 is attributed entirely to price level changes.

13. Changes in Cost Allocation and Apportionment. The project costs are allocated as specified in the Phase I GDM. The local cooperator's responsibilities have not changed as a result of the Phase II study. The real estate requirements and utility relocation costs have increased the local cooperator's financial responsibility by $217,000 due to the project design changes, and $15,000 due to price level increases, but have not affected the project's cost allocation or apportionment.

Table 2 - Cost Comparison Between Phase I GDM and Phase II GDM Estimates

Item	Phase I GDM Estimate (Oct 1978 Price Levels) Quantity	Total	Price Level Increase Between Oct 1978 and Oct 1979	Design Change Increase Between PH I and PH II GDM Estimates	Phase II GDM Estimate (Oct 1979 Price Levels) Quantity	Total
		$	$	$		$
CHANNEL		(3,245,000)*	(208,000)	(3,817,000)		(7,270,000)
Clearing	22.85 AC	56,130	3,600	8,170	17 AC	67,900
Care of Water		0	0	60,950	LS	60,950
Excavation						
Common	110,475 CY	541,720	34,800	1,176,480	360,000 CY	1,753,000
Rock	13,982 CY	524,400	33,700	405,120	70,760 CY	963,220
Earthfill	62,180 CY	291,630	18,700	-35,230	53,450 CY	275,100
Concrete	5,686 CY	700,230	44,800	1,691,460	8,550 CY	2,436,490
Shotcrete		0	0	47,900	LS	47,900
Riprap/Gabion	25,022 SY	985,220	63,100	-171,490	528,100 CY	876,830
Prepare Foundation		0	0	31,090	170 SQ	31,090
Spoil		0	0	604,620	310,000 CY	604,620
Support W. 25th Street Bridge		0	0	109,700	LS	109,700
Seeding Landscaping	19.8 AC	145,670	9,300	-112,370	25 AC	42,600
Zoo Gate		0	0	600	LS	600
RELOCATIONS		(1,065,000)	(68,000)	(3,067,000)		(4,200,000)
Road Repairs	LS	16,200	1,000	25,800	LS	43,000
New Railroad Tracks	4,400 LF	312,220	19,900	1,658,880	5,750 LF	1,991,000
Replace B&O Railroad Bridge	1 EA	368,290	23,550	37,160	1 EA	429,000
Trestle		0	0	137,000	1 EA	137,000
New Railroad Bridge	1 EA	368,290	23,550	208,160	1 EA	600,000
Utilities		0		1,000,000	LS	1,000,000
TOTALS		4,310,000	276,000	6,884,000		11,470,000

* Bracket numbers are subtotals and appear on PB-3 (Table 3).

REPORTS CONTROL SYMBOL DAEN-CWB-11

PROJECT COST ESTIMATE (PB-3) (AMOUNTS IN THOUSANDS OF DOLLARS)	DIVISION NORTH CENTRAL DISTRICT BUFFALO REGION GREAT LAKES BASIN SOUTHEASTERN LAKE ERIE	APPROPRIATION TITLE CONSTRUCTION, GENERAL CLASS FLOOD CONTROL - LOCAL PROTECTION	PROJECT CUYAHOGA RIVER BASIN, OH	DATE PREPARED 1 May 1979 EFF DATE 1 Oct 79 PAGE 1 OF 1 PAGES

LINE NO	COST ACCT. NO.	ITEM	% M L	COST ESTIMATE		AMOUNT OF CHANGE			CONDITIONED # 2	JUSTIFICATION OF REVISION
				CURRENT	PREVIOUS	TOTAL	PRICE LEVEL	OTHER		
	(a)	(b)	(c)	(d) 3/	(e)	(j)	(g)	(h) 4/	(i)	(l)
1		1970 R&H ACT, SECTION 108								1/ Includes $10,000 E&D cost incurred on
2	.02	RELOCATIONS		4,200.0	1,065.0	+3,135.0	+68.0	+3,067.0		Pilot Sediment Project before its termination.
3		B&O RR Bridge, Track and Repair Roads		(2,600.0)	(696.0)	(+1,904.0)	(+44.0)	(+1,860.0)		2/ Includes $18,000 for real estate activities.
4		Construction of new railroad bridge		(600.0)	(369.0)	(+231.0)	(+24.0)	(+207.0)		3/ Based on the detailed design as presented
5		UTILITIES		(1,000.0)	0	+1,000.0)	(0)	(+1,000.0)		in the Phase II GDM (Jan 79 P.L.) dated Mar. 1979 escalated to estimated Oct. 1979
6	09.	CHANNELS		7,270.0	3,245.0	+4,025.0	+208.0	+3,817.0		price levels.
7		Big Creek		(7,270.0)	(3,245.0)	(+4,025.0)	(+208.0)	(+3,817.0)		4/ Increase due to changed physical conditions
8	30.	ENGINEERING AND DESIGN 1/ 2/	52	730.0	655.0	+75.0	0	+75.0	97	in the project area, realignment and re-location of various project features,
9	31.	SUPERVISION & ADMINISTRATION		800.0	345.0	+455.0	+22.0	+433.0	43	unacceptable characteristics of the natural materials involved, and
10		Supervision & Inspection		(550.0)	(216.0)	(+334.0)	(+14.0)	(+320.0)		Engineering refinements. Detailed explanation of cost increases
11		Overhead		(250.0)	(129.0)	(+121.0)	(+8.0)	(+113.0)		by project feature is contained in the Phase II GDM dated Mar. 1979 currently
12		Total Federal Cost (CofE)		13,000.0	5,310.0	+7,690.0	+298.0	+7,392.0		under review and pending approval by HQD.
13		NON-FEDERAL COSTS								
14		LANDS & DAMAGES		407.0	216.0	+191.0	+14.0	+177.0		
15		RELOCATIONS - Modify road		58.0	17.0	+41.0	+1.0	+40.0		
16		in Brookside Park and Utility Relocations								
17		TOTAL Non-Federal Costs		465.0	233.0	+232.0	+15.0	+217.0		
18										

ENG FORM 2382, 1 NOV 74 (ER 11-2-240) EDITION OF 4 JAN 71 IS OBSOLETE. (TRANSLUCENT)

TABLE 3

REPORTS CONTROL SYMBOL: DAEN-CWB 13

PROJECT COST ESTIMATE (PB-3)
(AMOUNTS IN THOUSANDS OF DOLLARS)

DIVISION: NORTH CENTRAL
DISTRICT: BUFFALO
REGION: GREAT LAKES
BASIN: SOUTHEASTERN LAKE ERIE

APPROPRIATION TITLE: CONSTRUCTION, GENERAL
CLASS: FLOOD CONTROL - LOCAL PROTECTION

PROJECT: CUYAHOGA RIVER BASIN, OH

DATE PREPARED: 1 May 1979
EFF DATE: Oct 1979
PAGE 1 OF 1 PAGES

LINE NO.	COST ACCT. NO. (a)	ITEM (b)	% H.L. (c)	COST ESTIMATE CURRENT (d)	COST ESTIMATE PREVIOUS (e)	AMOUNT OF CHANGE, TOTAL (f)	AMOUNT OF CHANGE, PRICE LEVEL (g)	AMOUNT OF CHANGE, OTHER (h)	% COMMITTED (i)	JUSTIFICATION OF REVISION (j)
1										
2		SUMMARY OF ESTIMATED COSTS								
3		FEDERAL COST:								
4		Corps of Engineers		13,000.0	5,310.0	+7,690.0	+298.0	+7,392.0		
5		U.S. Coast Guard (None)								
6		Non-Federal Costs		465.0	233.0	+232.0	+15.0	+217.0		
7										
8		Total Federal and Non-Federal								
9		Costs		13,465.0	5,543.0	+7,922.0	+313.0	+7,609.0		
10										
11		Basis of Estimate, Federal and Non-Federal:								
12		The Big Creek Flood Control project cost estimate, first presented to Congress in the FY 73 Budget, was based on the reconnaissance								
13		investigation recorded in the Cuyahoga River Restoration Study's 1st Interim Report. This cost estimate was periodically updated								
14		(by price level) to the project cost ($1,680,000) presented in the FY 77 Budget submittal. During FY 76, a detailed Phase I GDM								
15		investigation was undertaken to evaluate the Big Creek Flood Control Project. The evaluation determined that the hydrology and limits								
16		of the project needed to be revised to adequately reflect the current flooding conditions in the watershed and to provide the								
17		protection required. The Big Creek Flood Control project was subsequently reformulated and the cost estimate revised in the								
18										

ENG FORM 2382, 1 NOV 74 (ER 11-2-240) EDITION OF 4 JAN 71 IS OBSOLETE. (TRANSLUCENT)

REPORTS CONTROL SYMBOL DAEN-CWP-13

PROJECT COST ESTIMATE (PB-3)
(AMOUNTS IN THOUSANDS OF DOLLARS)

DIVISION: NORTH CENTRAL
DISTRICT: BUFFALO
REGION: GREAT LAKES
BASIN: SOUTHEASTERN LAKE ERIE

APPROPRIATION TITLE: CONSTRUCTION, GENERAL
CLASS: FLOOD CONTROL - LOCAL PROTECTION

PROJECT: CUYAHOGA RIVER BASIN, OH

DATE PREPARED: 1 May 79
EFF DATE: 1 Oct 79
PAGE: 1 OF 1 PAGES

LINE NO	COST ACCT NO (a)	ITEM (b)	% H L (c)	COST ESTIMATE CURRENT (d)	COST ESTIMATE PREVIOUS (e)	AMOUNT OF CHANGE TOTAL (f)	AMOUNT OF CHANGE PRICE LEVEL (g)	AMOUNT OF CHANGE OTHER (h)	% COMMITTED (i)	JUSTIFICATION OF REVISION (j)
1		Basis of Estimate, Federal and Non-Federal (Cont'd):								
2		FY 78 Budget submittal to reflect $6,330,000 Federal (Corps of Engineers) and $387,000 Non-Federal costs. During January 1977 it								
3		became evident that the locals would not support the considered protection plan but desired and demonstrated a willingness to								
4		support an alternative plan evaluated during the Phase I GDM investigation. This plan reduced the scope of work and cost required								
5		to implement the flood protection project. The Phase II GDM report (March 1979) presented revised cost estimates of $12,263,000								
6		Federal (Corps of Engineers) and $439,000 Non-Federal. The costs have substantially increased as a result of changed physical								
7		conditions in the project area, realignment and relocation of various project features, unacceptable characteristics of the natural								
8		materials involved, and engineering refinements. The local cooperator (Cleveland Metroparks System) continues to support the								
9		project and is prepared to sign the LCA. Current estimates are based on the Phase II GDM estimates on January 1979 price levels,								
10		escalated to estimated October 1979 price levels by appropriate index and change in components in accordance with justification of								
11		revisions.								
12		Contingency Allowance								
13		Project status (April 1979)		Estimated Cost	Direct Cost	Contgy Allowance	% Contgy.			
14		Completed (None)								
15		Uncompleted but Committed (None)								
16		Not Yet committed		11,470.0	9,974.0	1,496.0	15			
17		Total		11,470.0	9,974.0	1,496.0	15			
18		a. Status of work committed but not completed b. Status of planning for work not yet committed				N A 97%				

ENG FORM 2382, 1 NOV 74 (ER 11-2-240) EDITION OF 4 JAN 71 IS OBSOLETE. (TRANSLUCENT)

Buffalo District
1 May 1979
(Date Prepared)

CUYAHOGA RIVER BASIN, OHIO

COMPARISON OF FEDERAL COST ESTIMATES

The current Federal (Corps of Engineers) Cost Estimate of $13,000,000 is an increase of $7,690,000 over the latest estimate ($5,310,000) presented to Congress. This change includes increases of $298,000 due to higher price levels, $6,884,000 based on more detailed plans and estimates and $508,000 in Engineering and Design and Supervision and Administration based on a recent reanalysis of requirements.

(The latest estimate presented to Congress was in the FY 1980 Budget Hearings based on October 1978 prices).

Buffalo District
1 May 1979
Date Prepared

CUYAHOGA RIVER BASIN, OHIO

EXPLANATION OF INCREASE IN PROJECT COST

The latest project cost estimate for Cuyahoga River Basin, OH shows an increase of $7,690,000 over the latest estimate presented to Congress. The increase is accounted for as follows:

Price Level			$+298,000
Price Escalation of Construction features		(+276,000)	
Salary Increase for E&D		(0)	
Price Level Increase for S&A		(+22,000)	
More Detailed Plans and Estimates 1/			+6,884,000
Relocations		(+3,067,000)	
B&O RR track and repair roads	+1,860,000		
Construction of new RR bridge	+207,000		
Additional utility relocations	+1,000,000		
Channels		(+3,817,000)	
Big Creek	+3,817,000		
Reanalysis of Requirements			+508,000
Engineering and Design		(+75,000)	
Increase based on increase in project first costs and additional E&D during construction	+75,000		
Supervision and Administration		(+433,000)	
Supervision and Inspection	+320,000		
Increase based on first cost of construction	(+320,000)		
Overhead	+113,000		
Total			$+7,690,000

1/ Detailed explanation of cost increases by project feature is contained in the Phase II GDM dated dated March 1979 currently under review and pending approval by NCD.

Buffalo District
1 May 1979
(Date Prepared)

CUYAHOGA RIVER BASIN, OHIO
(Project)

Summarized Financial Data	Last Estimate Presented to Congress (5-3/8%, Oct 1978)	Current Estimate (5-3/8%, Oct 1979) 1/
Estimated Federal Cost	$5,310,000	$13,000,000
Estimated Non-Federal Cost:	233,000	465,000
Cash Contribution	(0)	(0)
Other Costs	(233,000)	(465,000)

BENEFIT - COST ANALYSIS

	Last Estimate Presented to Congress (5-3/8%, Oct 1978)	Current Estimate (5-3/8%, Oct 1979) 1/	Percent of Benefit
Benefits (Average Annual):	$832,000	$973,700 2/	100
Flood Control	(782,000)	(840,000)	(86)
Area Redevelopment	(50,000)	(133,700)	(14)
Annual Charges:	331,300	830,200	
Federal	(312,100)	(794,700)	
Interest	285,400	736,300	
Amortization	22,500	57,900	
Maintenance	4,200	500 3/	
Non-Federal	(19,200)	(35,500)	
Interest	12,500	26,300	
Amortization	1,000	2,100	
Maintenance	5,700	7,100 3/	
Benefit-Cost Ratio	2.5 to 1	1.17 to 1 4/	

1/ Based on detailed design as presented in the Phase II GDM (Jan 79 F.L.) dated March 1979 escalated to estimated October 1979 price levels.

2/ Increase due to price levels. Indexes used were ENR building cost, local real estate values and consumer prices.

3/ Increase by ENR index.

4/ The B/C ratio decreased due to increased construction costs as presented in the Phase II GDM dated March 1979. Annual charges increased by 150 percent while benefits only increased 17 percent.

1 May 1979
Buffalo District
(Date Prepared)

CUYAHOGA RIVER BASIN, OH

BENEFIT-COST RATIO (CONT'D)

1. Period of Economic Analysis Assumed:

Big Creek Flood Control Project - Assumed 50-year life.

Pilot Sediment Removal - An investigation during 1976 revealed that the sediment near Breckville, OH, was no longer polluted. Consequently the removal of this sediment (the Pilot Sediment Removal Project) is no longer considered a viable means of restoring the water quality in the Cuyahoga River. A Letter Report submitted in July 1976 recommending termination of that program was approved on 9 December 1976.

2. Basis- Project functions independently.

3. Derivation of Benefit-Cost Ratio: The benefit-cost ratio for the Big Creek Flood Control project is 1.17 to 1, using an interest rate of 5-3/8, based on its functioning independently as a flood control project. In computing the benefit-cost ratio, the project was credited with average annual benefits of $973,700 attributable primarily to flood control and at an annual cost of $830,200.

COMPUTATIONS USED IN DETERMINING THE NON-FEDERAL CASH CONTRIBUTION

Not applicable for the Cuyahoga River Basin, Ohio project.

Non-Federal cash contribution - None.

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

PHASE II
GENERAL DESIGN MEMORANDUM

AUGUST 1979

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PLATES

PLATES

APPENDICES

* Under separate cover.

DEPARTMENT OF THE ARMY
Buffalo District, Corps of Engineers
1766 Niagara Street
Buffalo, New York 14207

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

PHASE II
GENERAL DESIGN MEMORANDUM

PERTINENT DATA

PROJECT LOCATION: City of Cleveland, Cuyahoga County State of Ohio.

PROJECT PURPOSE: Flood Control.

PROJECT AUTHORIZATION: Section 108 of Public Law 91-611, "River and Harbor Act of 1970".

LOCAL SPONSOR: Cleveland Metroparks System.

PROJECT ECONOMICS:

First Costs

Federal	$13,889,000
Non-Federal	666,000
Total	$14,555,000

Annual Costs

Construction (Amortized)	$ 844,040
Operation and Maintenance	12,300
Total	$ 856,340

Benefits

Average Annual Benefits	$ 941,000

Benefit-Cost Ratio

B/C Ratio	1.10

AREA DATA:

Drainage Area (Square Miles)	38
Project Design Storm (cfs)	12,000

PROJECT FEATURES:

FLOODWAY CHANNEL:

Length, Including Chute-Transition and Gabion Drop Structures (Linear Feet)	2,700
Length, Exluding Chute-Transition (Linear Feet)	2,150
Bottom Width, Exluding Chute-Transition and Gabion Drop Structures (Feet).	85-100
Side Slopes, Exluding Chute-Transition 1V on 2.5H Bedslope, Excluding Chute-Transition and Gabion Drop Structures (Percent).	0.071-0.690
Maximum Water Depth, Design Flood (Feet)	10.5

Concrete Chute-Transition:

Length (Linear Feet).	550
Bottom Width (Feet)	90-130
Height of Walls (Feet).	5.3-11.7
Bedslope (Percent).	0-0.085

Gabion Drop Structures:

Number of Structures.	5
Length, Each (Linear Feet). . . .	70
Drop (Feet)	1.9-3.5
Width at Control Section (Feet) .	55-70

Levee:

Length (Linear Feet)	810
Top Width (Feet)	10.0
Side Slopes	1V on 2.5H
Maximum Height (Feet)	10.0
Maximum Depth Cutoff and Exploratory Trench (Feet)	6.0

Zoo Access Road:

Length (Linear Feet)	460
Width (Feet)	24
Maximum Height Embankment (Feet)	11.0

MODIFIED CHANNEL:

Length, Including Riprapped Transition and Concrete Transition (Linear Feet)	2,120
Length, Excluding Riprapped Transition and Concrete Transition (Linear Feet)	1,970
Bottom Width, Exluding Riprapped Transition and Concrete Transition (Feet)	30-175
Side Slopes, Excluding Riprapped Transition and Concrete Transition	1V on 2.5H
Bedslope, Excluding Riprapped Transition and Concrete Transition (Percent)	0.25
Maximum Water Depth, Design Flood (Feet)	16.8

Low-Flow Channel in Rock:

Length (Linear Feet)	1,970
Bottom Width (Feet)	30.0
Side Slopes	1V on 2H & 1V on 2.5H
Maximum Depth (Feet)	3.0

Riprapped Transition at Two-Barrel Conduit (Bottom Only):

Length (Linear Feet)	63
Bottom Width (Feet)	72-102
Bedslope (Percent)	4.48

Earthfill at Zoo Floodplain:

Length (Linear Feet)	685
Maximum Width (Feet)	25
Maximum Height (Feet)	3

Concrete Transition @ Three-Barrel Conduit:

Length (Linear Feet)	100
Bottom Width (Feet)	30-70
Height of Walls (Feet)	12.1-15.1
Bottom Slope (Percent)	0-6.225

DIVERSION CHANNEL:

Length, Including Flume (Linear Feet)	1,000
Length, Exluding Flume (Linear Feet)	800
Bottom Width, Including Flume (Feet)	50.0
Side Slopes, Excluding Flume	1V on 2H
Bedslope, Excluding Flume (Percent)	0.50
Maximum Water Depth, Design Flood (Feet)	12.2

Concrete Flume:

Length (Linear Feet)	198
Bottom Width (Feet)	50.0
Height of Walls (Feet)	12.2-16.5
Bottom Slope (Percent)	1.25

Concrete Retaining Walls (T-Walls):

Length (Linear Feet)	140
Height (Feet)	19.5

RAILROAD RELOCATIONS:

Baltimore and Ohio Railraod Mainline:

Length, Including Bridge (Linear Feet)	4,950
Number of Tracks	1
Number of New Bridges	1
Maximum Height of Embankment (Feet)	33
Existing Track Removal (Linear Feet)	4,750
Number of Bridges Removed	1

Baltimore and Ohio Railraod Spurline:

Length, Including Bridge (Linear Feet)	1,290
Number of Tracks	1
Number of New Bridges	1
Maximum Height of Embankment (Feet)	5.0
Existing Track Removal (Linear Feet)	1,200
Number of Bridges Removed	None

Baltimore and Ohio Railroad Mainline Bridge:

Total Length (Feet)	78
Span Length (Feet)	78
Number of Tracks	1
Number of Piers	None
Height, Bottom of Channel to Low Chord (Feet)	18.5

Baltimore and Ohio Railroad Spurline Bridge:

Total Length (Feet)	152
Span Length (Feet)	76
Number of Tracks	1
Number of Piers	1
Height, Bottom of Channel to Low Chord (Feet)	14.5

INVERT ELEVATIONS (Mean Sea Level):

Floodway Channel:

Upstream End of Chute-Transition	633.0
Downstream End of Chute-Transition	621.3
Downstream End of Floodway Channel at Confluence with Modified Channel	603.1

Modified Channel:

Upstream End Two-Barrel Conduit	621.0
Downstream End Two-Barrel Conduit	615.8
Upstream End Three-Barrel Conduit	610.5
Downstream End Three-Barrel Conduit	604.5
Downstream End of Modified Channel	595.5

Diversion Channel:

Control Section at Flume	598.5
Downstream End at Big Creek	592.0

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

PHASE II
GENERAL DESIGN MEMORANDUM

I. INTRODUCTION

1. Introduction. The purpose of the Phase II General Design Memorandum is to present the detailed design of the Big Creek Flood Control Project, Cleveland, Ohio. This report describes the local cooperative requirements, and it describes the costs and benefits that have occurred due to changes in design and price levels since preparation of the Phase I General Design Memorandum.

II. LOCAL COOPERATION

2. Local Cooperation. Updated local cooperation in accordance with Section 108 of Public Law 91-611, passed on 31 December 1970, entitled River and Harbor Act of 1970 (Project Authorization) and as modified by project changes contained herein, require that, before construction can start, the official local sponsor must agree to:

a. provide without cost to the United States, all lands, easements, rights-of-way, disposal areas, and borrow areas necessary for construction and subsequent maintenance of the project;

b. provide without cost to the United States all relocations of buildings, utilities, highways and highway bridges necessary for construction and subsequent maintenance of the project, except relocations of utility lines passing through or under the proposed channel, considered to be integral parts of the channel improvements within the rights-of-way of the project;

c. hold and save the United States free from all claims for damage incident to construction and subsequent maintenance of the project, except for damage due to the fault or negligence of the Government or its Contractors;

d. prescribe and enforce regulations to prevent encroachment on channels and rights-of-way necessary for proper functioning of the project;

e. operate and maintain the project after completion in accordance with regulations prescribed by the Secretary of the Army;

f. comply with the applicable provisions of the "Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970", Public Law 91-646, approved 2 January 1971, in acquiring all lands, easements, rights-of-way, disposal areas, and borrow areas necessary for construction and subsequent maintenance of the project;

g. annually inform principal users of properties within the project area and floodplain vicinity of the extent and degree of protection provided by the project.

3. The Cleveland Metroparks System, the proposed cooperating agency for this project, by a resolution adopted 7 February 1977, formally agreed to support the plan and accept the conditions of local cooperation similar to those described above. The local cooperator is aware of the project changes described herein. There have been no changes in the views of the local cooperator concerning support for this project.

4. Section 221 of Public Law 91-611, requires that written agreement be executed between the Secretary of the Army and local interests prior to commencement of construction. The Cleveland Metroparks System, as project sponsor, must furnish the assurances required of local interests for Federal flood control projects. They are also responsible for acquiring easements and for accomplishing the non-Federal construction. As of this writing, assurances have not been received from the Cleveland Metroparks System. However, prior to construction of the project such an agreement will have to be obtained. The office responsible for fulfillment of local cooperation for the authorized plan is:

Cleveland Metroparks System
55 Public Square
Cleveland, Ohio 44113

III. LOCATION OF PROJECT AND TRIBUTARY AREA

5. Location. The Big Creek drainage basin, comprising some 38 square miles, is located in northeastern Ohio, wholly within Cuyahoga County. Big Creek flows generally northward into Cuyahoga River and thence to Lake Erie. Location and vicinity maps are shown on Plate 1.

6. Description of Watershed. The watershed measures about 10 miles in overall length north and south and about 6 miles in width east and west. The watershed includes the cities of Parma Heights and Brooklyn; sizeable tracts of the cities of North Royalton, Parma, Brook Park, and Cleveland; and a small tract of the city of Middleburg Heights. The upper part of the watershed is moderately rolling and slopes generally northward. The central

portion is gently rolling and slopes generally northeastward. The watershed slopes from Elevation 1260 in the town of North Royalton to Elevation 680 near the mouth of the watershed on the Cuyahoga River. The project area lies within the confines of the City of Cleveland.

7. Tributary Area. Approximately 70 percent of the watershed is urbanized; most of this land is used for housing. The remainder of the watershed comprises open space and wood lots. The floodplain is used for recreation, transportation, and industry. The floodplain in the project area is occupied by the Metroparks Zoo and Brookside Industrial Park. The remainder of the floodplain is used for industry and open space; most is used for trucking industries.

IV. HYDROLOGY AND HYDRAULICS

8. Climatological Data. The climatological data available near the site is good. The average annual precipitation is 30.49 inches, varying from an average low of 2.18 inches in February to a high of 3.49 inches in both April and May. The average annual snowfall is 50.5 inches and the average annual temperature is 49.7 degrees Fahrenheit. More complete data and a description of the available weather stations are in Appendix C.

9. Summary of Basis of Studies and Results. The basis of the studies and results developed to properly design this flood control project are discussed in detail in Appendix C. A design discharge of 12,000 cfs for the considered plan of improvement was selected in the Phase I GDM. The Phase II study attempted to maximize the flow capacity of the project features but, because of space limitations between the West 25th Street Bridge piers, the maximum discharge that passes through this restriction was also 12,000 cfs. Results of the subsurface exploration program, spacial limitation and site changes necessitated the hydraulic changes made to the project. The USGS gaging station at Brookside Park, just upstream of the project site, has 6 years of continuous record. A unit hydrograph was derived from the one flood for which a runoff hydrograph was available. During the analysis, it became necessary to revise the rating curve used by the USGS in

order to more accurately match the one major flood recorded by the gage to the recorded rainfall. Details of the revision, as well as the adopted rating curve, are presented in Appendix C.

10. The design discharge approved for the project is 12,000 cfs, which has a recurrence interval of 100 years based on a derived unit hydrograph and on a frequency analysis of the rainfall. This compares very favorably with an analysis of the runoff using a synthetic method as shown in Appendix C on Plate C6. There are insufficient years of record to analyze the peak annual streamflows for return period.

11. Standard Project Flood. While the proposed project document plan will provide considerable flood protection up to and including a 100-Year frequency event, storms of greater magnitude can occur. The largest flood that can be experienced from the most severe combination of meteorological and hydrological conditions that is considered reasonably characteristic of the geographical region involved is defined as the "Standard Project Flood" (SPF). As indicated in Appendix C, the SPF was computed to range between 30,000 and 35,300 cfs. As this discharge is way above any for which a feasible project could be formulated, a more refined estimate for the SPF is not warranted.

12. Design Channel Flows. The project features such as channel enlargements, diversions, and levees are not designed to protect against the standard project flood because such a project cannot be economically justified. The design discharge for the project was selected to provide the highest degree of protection economically justifiable. The design discharge for the project is the 100-Year Flood of 12,000 cfs.

13. Water Surface Profiles. The elevation of the water surface at various points in the project was computed using computer program 723-X6-L202A, HEC-2, "Water Surface Profiles". These computations were augmented by hand calculations for flow through the two-barrel and three-barrel conduits. The input criteria is listed in Appendix C. These computations were used not only to determine the design water surface profile for the 100-Year Flood, but also to modify the USGS rating curve, as previously described. A more detailed description is presented in Appendix C.

14. Riprap and Gabion Protection. Riprap and gabion protection is proposed at various locations along the project. Design criteria, assumptions, methods, calculations, and a

complete description of the protection are presented in Appendix D.

15. Sedimentation. The purpose of discussing sedimentation in this report is to evaluate the potential sediment problems in the project area along Big Creek. The proposed project will increase the efficiency of the existing creek. Thus, there will be an increase in the sediment transporting capacity of the creek. However, it is not anticipated that there will actually be an increase in the sediment transported. The erosion potential of the channel within the project area will be reduced by providing for bank protection upstream and downstream of bridges, at sharp channel bends, and at locations where the average channel velocity greatly exceeds six feet per second. The erosion potential upstream and downstream of the project area will not be affected by this project. Sediment transport is accomplished by three different processes: suspension, contact or traction (bed load), and saltation. Observations of Big Creek suggest that bed load is not great. The bed load is of greatest importance in the formation of bed and banks. Consequently, in this project, the sediment transported by bed load would be of most interest as it could affect the mechanics of the creek. Since bank stabilization and deposition are not presently considered problems along Big Creek, the improved conditions are not anticipated to affect the transport of sediment either. It does not appear that a sedimentation problem exists on Big Creek, and any problems that may occur can readily be handled as part of the project's regular maintenance. A more detailed discussion on sedimentation is presented in Appendix A.

V. GEOLOGY AND SOILS

16. Physiography and Topography. The site of work along Big Creek lies within the Erie Plain of the Central Lowland Physiographic Province. The Erie Plain is characterized by somewhat rolling topography which slopes regionally to the northwest. In the vicinity of the project site, Big Creek has deeply dissected the regional topography, providing local relief of upwards to 125 feet. Along most of its

exposed length, Big Creek flows over a shale bedrock surface. In places, small bedrock riffles and pools have formed. At other places, the bedrock is covered by a thin veneer of platy shale gravel. Outcrops of bedrock occur throughout the Big Creek Valley.

17. General Geologic Setting. Bedrock within the project site consists predominantly of soft, blue-grey shale. The shale represents a portion of the Chagrin Formation of Devonian Age. Although the bedrock is termed soft geologically, it is suitable for the intended use. Erosion and downcutting by Big Creek have removed all traces of glacial deposits within the immediate vicinity of the project site. Most of the soil cover within the study area has been re-worked by the activities of man. Natural soils remaining are predominantly fluvial or floodplain soils. Subsoils are composed principally of sandy, silty clay. The on-site geology inspection did not reveal any signs of instability with outcrops in the project area. The air-slaking characteristic of the shale was evident as loose rock from the air-slaking process was found at the toes of rock slopes. The slopes of the outcrops are generally slightly steeper than 1V on 1H. No evidence of slump topography was noted on the overburden slopes in the project area.

18. Bedrock Geology. Blue-grey shale predominates throughout the project site. It is exposed nearly continuously in the creek bottom throughout the limits of the project. The outcrops of bedrock in the vicinity of the project show the shale to be horizontally bedded. The shale bedrock surface is moderately uniform with an overall slope to the east (downstream) within the project site. The shale has the characteristic of air-slaking. Some grey siltstone exists at the project site; however, the amount is insignificant compared to the shale. Further description of the bedrock geology is contained in Appendix A.

19. Project Soils. Overburden within the project site is characterized by both natural, in-place soils and soils re-worked for use in structures such as railroad embankments and highways. Whether re-worked or natural, the overburden is dominated by sandy, silty clay. The sandy, silty clay varies from light to medium grey and commonly contains shale fragments. Other project soils include brown, sandy, clayey silt; sand varying from fine-to-coarse grained; and gravel in the form of stream gravel or as shale fragments.

20. Several different types of fill are present within the project site. Silty coarse gravel fill is present throughout the length of the project as railroad ballast. Fill composed of pebbly to gravelly sand has been used as cover in the Zoo parking lot at the upstream end of the project. Volumetrically, the dominant type of fill is in the trash pile located at the right bank of the diversion channel downstream from the West 25th Street Bridge. Fine material included with the trash pile fill consists of a heterogeneous mix of clay, silt, and sand; foundry sand; and pebbles of variable composition. Among the types of material which comprise the trash are: miscellaneous types of organic debris; wood of varying sizes and types; glass; bricks; sheet metal; tires; mattresses; automobiles and various automobile parts including engine blocks; coal; and other types of material. Further description of the project soils is contained in Appendix A.

21. Geologic and Soil Conditions Affecting Design and Construction. The trash material at the diversion channel is not suitable for use as a fill and it must be hauled to an offsite spoil area. Also, some of the project soil is high in moisture content. This soil will either have to be spoiled or its moisture content will have to be reduced before it can be utilized as a project fill. The high moisture content material would not be suitable even for the less critical project fill materials, such as, the earthfill on the trashpile, fill at the Zoo floodplain, and fill for protection of air-slaking shale. Although these project fill materials are less critical than railroad embankment fill or levee fill, they still must be compacted after placement and therefore cannot be excessively wet. However, it is possible that the moisture content could be slightly higher than that required for the railroad embankment fill and levee fill provided that adequate compaction is obtained. The upper limit of the allowable moisture content for the less critical project fill materials would have to be determined during construction. Because of the air-slaking characteristic of the shale at the project site, special measures will be required to protect the shale. Geologic and soil conditions at the project site were investigated for potential seepage problems at the levee and existing railroad embankment at the upstream end of the project. Results of the investigation showed that seepage is not anticipated to be a problem, and that the danger of boils caused by underseepage is not a concern. A detailed discussion on these and other geologic and soil conditions affecting

design and construction are presented in Appendix A and Appendix B.

22. Slope Stability Analyses. Laboratory test results on soil samples obtained from the Subsurface Exploration Program were used in selecting adopted design values for use in the slope stability analyses. Adopted design values for trash pile material were based primarily on the angle of repose of the existing trash pile. The adopted design values along with a discussion on the selection of the adopted design values are presented in Appendix A. The stability analyses were run for both the construction condition and sudden drawdown condition. The slope stability analyses were run for channel side slopes in the floodway channel, modified channel, and diversion channel. Included with these were the slope stability analyses for the levee and relocated railroad embankment. Design criteria and the results of the slope stability analyses are presented in Appendix D.

VI. OTHER PLANS INVESTIGATED

23. Phase I GDM Studies. Several alternative plans were investigated during the preparation of the Phase I GDM. These alternative plans were referred to as: (1) Non-Structural Base Plan, (2) Brookside Park Reservoir Plan, (3) Brookside Park-Industrial Park Diversion Plan (50-Yr.), (4) Brookside Park-Industrial Park Diversion Plan (100-Yr.), (5) Brookside Park-Protector Products, Diversion Plan, and (6) Cleveland Zoo-Protector Products Floodway/Diversion Plan. Each alternative plan was considered for designation as the selected plan. The ability of each plan to serve the established planning objectives was determined through consideration of the following characteristics: (1) flood protection capability; (2) economic efficiency (benefit-cost ratio); (3) operational dependability; and (4) socio-environmental effects, including external damage effects. Each of these alternative plans is described in the Phase I GDM. The Cleveland Zoo-Protector Products Floodway/Diversion Plan was the Selected Plan.

24. Alternative Studies. Alternative studies of the Selected Plan were made and the results are presented in

Appendix B. The purpose of the alternative studies is to determine the least-cost and overall optimal development concept of the principal features of the Selected Plan. The alternative studies include a study of the alignments and grades of the floodway channel, modified channel, and diversion channel, and both the relocated Baltimore and Ohio Railroad mainline and spurline. Each alternative is technically feasible in that it meets the hydraulic and structural criteria established for the project; each alternative also meets the environmental objectives of the project. Generally, for individual features, the alternative studies were limited to the type of construction materials used and/or combinations thereof to arrive at the most economical means of construction. The geometry of certain features was studied to determine if there was a more economical design.

25. Since completion of the Phase I GDM, revisions to the alignments of the main features of the project were made. The main features include the floodway channel, diversion channel, modified channel, and the relocated Baltimore and Ohio Railroad mainline and spurline. Basically, these revisions were necessary because of a combination of factors, which included: (1) the results of the subsurface exploration program, (2) the use of an updated topographic map for the project site, (3) the need to satisfy the Baltimore and Ohio Railroad criteria, and (4) conflicts between project features and existing structures. Revisions to the alignments of the main features in turn affected some of the individual project features. The revisions were taken into consideration in the alternative studies of the individual project features. A more detailed discussion on these alignment revisions and their effects on the individual project features is presented in Appendix B.

26. The various alignments considered are not alternatives in the sense that there is a choice among them. The various alignments were necessary in order to find alignments of the principal features of the project that satisfied criteria, satisfied various constraints, and were also compatible with other project features. The alignments selected satisfy these requirements. The selected alignments are shown on Plates 4 through 7, inclusive. A description of the selected alignments and a discussion on how they differ from the Selected Plan presented in the Phase I GDM are presented in Appendix B.

27. After the alignments of the main features were selected, alternative studies on the individual project features were made. These studies involved the following: (1) channel side slope protection, (2) the chute-transition, (3) the Zoo access road, (4) a levee vs. floodwall comparsion, (5) a comparison of concrete, riprap, and gabion drop structures, (6) the mainline railroad bridge, (7) the spurline railroad bridge, (8) the right bank of diversion channel immediately downstream of the flume, (9) the diversion channel, and (10) protection of air-slaking shale. A description of the atlernatives considered and discussion on the selected alternatives are presented in Appendix B.

28. Plans by Other Agencies. There are no known plans by any agency at the Federal, State, or local level to provide changes that would affect the functioning of the Big Creek Flood Control Project.

VII. DESCRIPTION OF PROPOSED STRUCTURES AND IMPROVEMENTS

29. Flood Control Plan. The flood control plan for a reach of Big Creek in the City of Cleveland is designed to prevent flood damages for a 100-year discharge of 12,000 cfs. The plan involves a floodway channel, modified channel, and diversion channel. Associated with the flood control plan is the relocation of the Baltimore and Ohio Railroad mainline and spurline. The relocated mainline and spurline are discussed in Section XIV, Relocations. A general plan of the flood control plan is shown on Plate 2. Plan and profiles are shown on Plates 4 through 7, inclusive. Typical sections are shown on Plates 8 and 9. Following is a discussion of the features of the flood control plan.

30. Floodway Channel. The floodway channel is designed to convey excess discharge, so as not to overtax the main stream improvements. The design discharge for the floodway channel is 6,000 cfs. A reach of the floodway channel at the upstream end will be constructed over an existing two-barrel conduit. The floodway channel will start 280 feet downstream from the inlet of the two-barrel conduit, and it will extend for 2,700 linear feet to where it joins the

existing channel of Big Creek. The upper 550 linear feet of the floodway channel will be a concrete chute-transition, as discussed in Paragraph 38. The remainder of the floodway channel will be excavated into overburden and rock. There will be five gabion drop structures in this reach of the floodway channel. The side slopes will be 1V on 2.5H; and excluding the drop structures, the bottom width will vary between 85 and 100 feet. The drop structures will be provided to reduce the grade along the floodway. The grade of the floodway channel between the drop structures will vary between 0.071 and 0.69 percent. The drop structures will be trapezoidal control sections, providing drops varying between 1.9 and 3.5 feet, with 1V on 2.5H side slopes and bottom widths varying between 55 and 70 feet. Details of the drop structures are shown on Plate 16. A levee will be constructed along the right bank of the floodway channel, downstream from the chute-transition, as discussed in Paragraphs 34 and 35. A plan and profile of the floodway channel is shown on Plates 5, 6 and 7. Typical floodway channel sections are shown on Plate 9.

31. Modified Channel. Channel improvements will be provided along a 260-foot reach of the existing stream downstream from the three-barrel conduit and upstream from the confluence with the floodway channel. These channel improvements will consist of minor realignment and slope protection. The typical channel section proposed for this reach is a 30-foot bottom width and 1V on 2.5H side slopes. The design discharge for this reach is 6,000 cfs. Plan, sections, and details of this reach of the modified channel are shown on Plate 17. A concrete structure, to provide a transition from the three-barrel conduit to the modified channel, will be provided at the upstream end of this reach, as discussed in Paragraph 39.

32. Channel improvements will also be provided along a 1,860-foot reach of the existing stream between its confluence with the floodway channel and the West 25th Street bridge area. This reach is designed to convey the full project discharge of 12,000 cfs. The proposed mainline and spurline railroad bridges cross this reach of the modified channel, as discussed in Section XIV, Relocations. The proposed channel improvements will consist of widening and realigning, as well as slope protection in certain areas. The improved channel section will have 1V on 2.5H side slopes and a bottom width that will vary between 162 feet at the upstream end of the reach to 116.5 feet at the spurline bridge to 175 feet at the West 25th Street bridge.

A low-flow channel with a 30-foot bottom width will be provided 3 feet below the improved channel grade. The modified channel will terminate just downstream from the mainline bridge. Between the spurline bridge and the downstream end of the channel modification, the low-flow channel will transition to the natural channel. The area between the spurline bridge and the mainline bridge will be widened as required to provide approaches to both the diversion channel and the natural channel at the mainline bridge. A plan and profile of the modified channel is shown on Plates 4 and 5. Typical sections are shown on Plates 8 and 9.

33. Diversion Channel. The diversion channel will extend for 1,000 linear feet from the upstream side of the West 25th Street bridge to existing Big Creek channel. The diversion channel will cut off a loop of the existing channel. The design discharge in the diversion channel is 7,000 cfs; the remainder of the project discharge of 5,000 cfs will be conveyed by the existing channel. A concrete flume will be provided at the upstream end of diversion channel, as discussed in Paragraph 40. The remainder of the diversion channel is a cut in trash material, natural overburden, and rock. The diversion channel will have a 50-foot bottom width with 1V on 2H side slopes. The bottom and side slopes will be protected with riprap. A plan and profile of the diversion channel is shown on Plate 4. Typical diversion channel sections are shown on Plate 8.

34. Levee and Earthfill in Zoo Floodplain. A levee will be provided along the floodway channel, and earthfill will be placed in the Zoo floodplain along the existing channel. Both the levee and earthfill will prevent floodwaters from encroaching on the area to be protected.

35. The levee will extend along the right bank of the floodway channel from the downstream end of the chute-transition to where it intersects the embankment of the existing Baltimore and Ohio Railroad. Between the levee and the confluence of the floodway channel and the modified channel, the existing railroad embankment will act as a levee. The levee will extend along an 810-foot reach of the floodway channel. The levee will have a 10-foot top width with 1V on 2.5H side slopes. The side slope on the channel side will be a continuation of the levee cut slope. An exploratory and cutoff trench will be provided. It will have a 10-foot bottom width with 1V on 1H side slopes, and it will have a maximum depth of 6 feet. A drain to intercept seepage both through the levee and the foundation

will be provided at the landward toe. The height of the levee will vary, and it will have a maximum height of 10 feet, as measured from the existing ground surface. A plan of the levee is shown on Plates 6 and 7, and typical levee sections are shown on Plate 9.

36. The earthfill in the Zoo floodplain will extend along a 685-foot reach of the left bank of the existing channel between the Zoo bridge and upstream end of the three-barrel conduit. The earthfill will raise the overbank above the design flood elevation. The earthfill will be placed to a specific grade and alignment, and it will be placed to a specific cross-section. A plan and profile of the earthfill is shown on Plate 7. Typical sections are shown on Plate 15. The upstream end of the earthfill will tie into the Zoo access road, and the downstream end will tie into high ground. The top width of the earthfill will be 10 feet, and the side slope will be 1V on 2.5H on the channel side and 1V on 4H on the landside. The maximum height of the earthfill will be 3 feet, as measured from the existing ground at the landside toe.

37. Structures. The General Plan shown on Plate 2 identifies the structures along the Big Creek Flood Control Project. All sturctures will accommodate the project design discharge without restriction. A discussion on the Baltimore and Ohio Railroad mainline and spurline bridges is presented in Section XIV, Relocations. A discussion on other project structures is presented in the following paragraphs.

38. A concrete chute-transition will be provided at the upstream end of the floodway channel. The upstream end of the chute-transition will be constructed over on existing two-barrel concrete conduit. The chute-transition is designed to pass a discharge of 6,000 cfs. It will channel flows that will overtop the entrance of the two-barrel conduit, provide conditions to create a hydraulic jump, still the jump, and then transition it to the floodway channel downstream. It is also designed to act as a roadway for John Nagy Boulevard, which presently extends along the site of the chute-transition. The total length of the structure will be 550 feet. It will vary in width from 90 to 130 feet. The height of the walls will vary from 5.3 to 11.7 feet. Vertical curves will be provided at changes in grade to accommodate vehicular traffic. A median strip and curbs will be provided in the chute-transition for vehicular guidance and safety. The normal flow of traffic will pass

along the structure and through an opening in the left wall at Brookside Park Drive. New roadway facilities will be provided from the opening to a point on the existing Brookside Park Drive. The new roadway facilities will be at the Baltimore and Ohio Railroad and Norfolk and Western Railroad underpasses. This is discussed further in Paragraph 42. Plan, profiles, and sections of the access to Brookside Park Drive are shown on Plate 13. An opening will also be provided in the right wall of the chute-transition at the existing Zoo road. New roadway facilities will be provided for access to the Zoo from this opening, as discussed in Paragraph 41. Plan, profile, and sections of the Zoo access road are shown on Plate 14. A plan and profiles of the chute-transition are shown on Plate 10. Typical sections are shown on Plates 11 and 12. Details of the chute-transition are shown on Plate 12A.

39. A concrete transition will be provided at the downstream end of the three-barrel conduit. It is designed to pass a discharge of 6,000 cfs. It will transition flows from the three-barrel conduit to the modified channel. At the upstream end, the transition will tie into an existing slab and wingwalls. The total length of the structure will be 100 feet. It will vary in width from 30 to 70 feet. The height of walls will vary from 12 to 15 feet. A plan, sections, and details of the transition are shown on Plate 17.

40. A concrete flume will be provided at the upstream end of the diversion channel. It is designed to pass a discharge of 7,000 cfs. The flume will provide hydraulic control for flows entering the diversion channel. The flume will be constructed between piers of the West 25th Street bridge. The total length of the flume will be 198 feet. The width will be constant at 50 feet. The height of walls will vary from 12.2 to 16.5 feet. The base of the bridge pier at the right side of the flume is above the grade of the flume, and the pier is close to the flume. Because of this, a special support system will be provided to support pier loadings that will be transferred to the flume walls. The support system will consist of structural steel members and pre-cast concrete lagging. The structural steel members will be supported by concrete anchors. The support system will become an integral part of the flume. A concrete wingwall will be provided upstream of the flume at the right side. The wingwall will be a T-wall. The height of the wall will be 19.5 feet. A concrete T-wall will also be provided at the upstream end of the flume between the flume and the abutment of the

railroad mainline bridge. The wall will have a height of 19.5 feet. Plan, sections, and details of the flume and associated walls are shown on Plates 18 and 19.

41. Roads. No public roads will be permanently modified by the proposed work, except for John Nagy Boulevard, which is an integral part of the chute-transition, as previously discussed. There presently is access to the Zoo from John Nagy Boulevard. Because of the chute-transition, the Zoo access road will be modified. The modification is necessary in order to prevent floodwaters from entering the Zoo area. The total length of modified Zoo access road is 460 feet. Plan, profile, and sections of the Zoo access road are shown on Plate 14. The Zoo access road is for Zoo personnel only. In order to keep the public from using the road, an entrance gate will be provided.

42. Modifications will also be necessary at Brookside Park Drive at the Norfolk and Western Railroad and Baltimore and Ohio Railroad underpasses. Modifications will be necessary because the final grade of the chute-transition is lower than the present road grade. The total length of modified roadway is 180 feet. Plan, profile, sections, and details are shown on Plate 13.

43. The bridge over the existing Baltimore and Ohio Railroad just downstream from the West 25th Street bridge is presently impassable and abandoned, with no active plans for its rehabilitation. It will be removed as part of this project.

44. Interior Drainage. No interior drainage facilities are necessary for the Big Creek Flood Control Project. Generally, interior drainage facilities are required for flood control projects involving levee construction. However, for this project, because the levee is along the floodway channel and not the main channel, surface drainage on the landside of the levee will not cause any flooding problems. Runoff on the landside of the levee will have positive drainage to the existing Big Creek channel.

45. Although the earthfill at the Zoo floodplain is along the existing Big Creek channel, it will not cause any interior drainage problems. Runoff on the landside of the earthfill will have positive drainage to the existing Big Creek channel.

46. Erosion Protection. Riprap or gabion protection will be provided on earthen slopes along reaches of high

channel velocity or where turbulence is expected. The rock at the project site is an air-slaking shale, which will deteriorate when exposed to wet-dry cycles. A detailed discussion on the air-slaking characteristic of the shale is presented in Appendix A. The deteriorated rock will be highly erodable. Where the channel bottom is in rock, in those areas where bedrock will be subject to wet-dry cycles and channel velocities will be low, the channel bottom will be overexcavated by 1-foot and compacted earthfill will be placed to grade and seeded. In those areas where channel velocities are high, the channel bottom will be overexcavated and riprap protection will be placed to grade. A detailed listing of the location and size of riprap and gabion protection is presented in Appendix D. Also, the above-mentioned erosion protection features are shown on the various plans, sections, and details shown on the plates.

47. Landscaping. Landscaping will be provided to improve the human environment. Landscaping criteria used is as follows:

a. No plantings will be permitted on channel slopes and 10 feet beyond the side slope intercept in order to provide access for maintenance operations. No plantings are provided on channel side slopes because the plantings both reduce the hydraulic efficiency and usually trap debris.

b. No plantings will be permitted on the levee or on the earthfill in the Zoo floodplain. No plantings are provided on these fills, which act to contain channel flows, because the root systems provide potential seepage paths in the fills.

c. Trees and shrubs will be adaptable to Climatic Zone 5, the zone of hardiness for the Cleveland area. Climatic Zone 5 (also referred to as Hardiness Zone 5) is a designated geographic area in which the mean coldest temperatures fluctuate within a range of -10° F to -5° F. A Hardiness Map can be found in the following references: (1) Trees for American Gardens by Donald Wyman (Macmillan, 1965)and (2) Shrubs and Vines for American Gardens by Donald Wyman (Macmillan, 1949).

48. The landscaping plan is shown on Plate 7. A summary of the proposed plantings is shown on Table 1. In general, the plantings are placed in areas where the features of the project may appear obtrusive to the public. Where the features of the project are usually only visible from a distance, such as the earthfill on the trash pile, landscaping is not provided because the improvement in visual impact will be minor. However, if there are existing tall trees, or if natural growth establishes itself after completion of the project, and if such are desirable to improve the human environment, then they should be allowed to remain provided that they do not interfere with the hydraulics, structures, or maintenance requirements of the project. The decision as to their status will be decided by the Contracting Officer during construction and by the inspector during the annual inspections. If there are particular visually objectionable areas of the project that become apparent after construction, additional plantings could be added as a modification to the project. Plantings have not been added to the relocated Baltimore and Ohio Railroad embankment because the plantings would interfere with the mowing of the slope. As noted in Paragraph 92, Property Relocations, the existing fencing in the levee area will be removed to the limit of the work area. It will be the responsibility of the local sponsor to remove or alter the fencing that remains.

TABLE NO. 1

PROPOSED PLANTINGS

Identification No.	Common Name	Botanical Name	Size	Total No.
1.	White Flowering Dogwood	Cornus florida	6'- 8'	1
2.	Leatherleaf Viburnum	Viburnam rhytidophyllum	18"-24"	3
3.	Japanese Andrameda	Pieris japonica	18"-24"	2
4.	Loboy Firethorn	Pyracantha loboy	15"-18"	8
5.	Border Forsythia	Forsythia intermedia spectabilis	18"-24"	6
6.	White Pine	Pinus strobus	8'-10'	2
7.	Mountain Laurel	Kalmia latifolia	18"-24"	4
8.	Japanese Flowering Crab	Malus floribunda	5'- 6'	2
9.	Andorra Juniper	Juniperus plumosa	15"-18"	4
10.	Myrtle	Vinca minor	3"	200
11.	Vanhoutte Spirea	Spirea vanhouttei	3'- 4'	8
12.	Pin Oak	Querus palustris	10'-12'	1
13.	Sugar Maple	Acer saccharum	10'-12'	1
14.	Mohave Firethron	Pyracantho Mohave	18"-24"	3
15.	Upright Japanese Yew	Taxus cuspidata capitata	5'- 6'	3

VIII. CONSTRUCTION PROCEDURES AND SEQUENCE

49. Construction Procedures. A sophisticated diversion plan will not be required for this project as runoff will continue to flow within the existing channel. Where construction will be performed in the wet, the construction will proceed in an upstream direction in order to provide positive drainage of the construction area. As permanent construction will have to be performed in the dry, a certain amount of stream diverting, cofferdamming, and pumping will be required. Construction procedures will have to be compatible with environmental protection requirements. This is discussed in Section IX, Environmental Analysis.

50. Construction of the Baltimore and Ohio Railroad spurline bridge will not require any unique or difficult procedures. However, in order to construct the Baltimore and Ohio Railroad mainline bridge abutments, the Norfolk and Western Railroad tracks must be placed on a temporary trestle. Trestle construction must be completed before any work can begin on the Baltimore and Ohio Railroad mainline bridge. Close coordination between the contractor and the Norfolk and Western Railroad will be required to minimize interruptions to the Norfolk and Western Railroad operations.

51. The special support system for the West 25th Street bridge pier at the right side of the diversion channel flume will require special construction procedures. The support system will be divided into units, and each unit will have to be completed before proceeding with the construction of the next adjacent unit. Such a procedure will be necessary because all the rock excavation required for the flume construction cannot be excavated before starting with the installation of the support system. Specific construction procedures will be outlined in the plans and specifications.

52. Construction Sequence. The main construction sequence requirement is that the relocated Baltimore and Ohio Railroad mainline and spurline must be completed and in service before the existing mainline and spurline can be removed. Any construction that does not affect the existing mainline and spurline can be performed simultaneously with the construction of the relocated

mainline and spurline. Any construction that affects the existing mainline and spurline must be performed after the relocated mainline and spurline are completed and in service. As long as these basic requirements are met, construction can proceed simultaneously in the diversion channel, modified channel, and floodway channel.

53. Construction of the relocated Baltimore and Ohio Railroad mainline and spurline will require a specific construction sequence because of the need to minimize interruptions to the railroad operations. The following is the general construction sequence that will be required. While the mainline bridge is being constructed, the embankments and excavations required for the relocated Baltimore and Ohio Railroad mainline and temporary spurline will be constructed. Upon completion of this task, the mainline and temporary spurline trackage will be completed. When railroad traffic has been shifted to the new alignments, the construction of the spurline bridge will be initiated. Upon completion of this task, the industrial yard trackage will be re-aligned to the final position. The stage construction procedures for the railroad relocations are presented on Plate 30.

IX. ENVIRONMENTAL ANALYSIS

54. Environmental Aspects of Departures from the Authorized Plan. The Draft Environmental Impact Statement (EIS) was completed in May, 1977. It was prepared to describe the existing area and to determine the impacts of the project document plan. Recommendations were made to mitigate impacts on vegetation, wildlife, fish, and the human environment. Responses and recommendations to the Draft EIS were made by various agencies and they were included in appendices to the Phase I GDM.

55. The only response that resulted in recommendations to revise the project came from the U.S. Fish and Wildlife Service of the U.S. Department of the Interior. Their recommendations were contained in a letter of 5 May 1977 and were later amended in a letter of 14 October 1977. Both these letters are in Appendix E of the Phase I GDM.

The final recommendation for the U.S. Fish and Wildlife Service was to include a low-flow channel with pools and riffles, in order to improve the aquatic habitat.

56. The Final Environmental Impact Statement (FEIS) was dated November, 1977 and was filed at the U.S. Environmental Protection Agency on 8 February 1978. Detailed design of the project features commenced in April, 1978. Because of the required modifications to the project, as described herein, it was necessary to reassess the environmental impacts of the project. This was accomplished with a Clarification Statement to the FEIS. The Clarification Statement was prepared in February, 1979, and sent to interested parties. The Clarification Statement is included in the Attachments to this Phase II GDM. The net assessment is that the proposed modifications to the Phase I GDM Plan will not have an adverse effect on the natural environment. The low-flow channel, which was recommended by the U.S. Fish and Wildlife Service, will mitigate the natural environmental impacts of the project. Modifications to the trash pile near the right bank of the diversion channel in the long run, will improve both the natural environment and human environment. Other modifications will have negligible environmental impacts. On 15 November 1978, a meeting was held with interested parties concerning the Clarification Statement. At the conclusion of the meeting, all the parties present specifically approved the proposed modifications to the project.

57. The low-flow channel will be included as a feature of the project. During the course of the design, a reassessment of the pools and riffles in the low-flow channel was made. It is not felt that they would provide significant ecological benefits. Instead, it is felt that allowing the rock excavation in the low-flow channel to be rough will accomplish the same purpose. A letter from the Buffalo District to the U.S. Fish and Wildlife Service concerning this matter is included in the Attachments to this Phase II GDM.

58. The impact of each feature of the project on both the natural environment and human environment is assessed in the Alternative Studies presented in Appendix B.

59. The only significant change to the Clarification Statement that has occurred since the Clarification Statement was issued will provide a beneficial impact on the project. Since the current project costs are above the

costs of the previously proposed project, additional work for the unemployed will be available. The increase in benefits (as described in the Phase I GDM) is assumed to be directly proportional to the increase in project costs, which are described in Section XV, Cost Estimates.

60. Specific requirements to mitigate the impact of the construction on the natural environment will be included in the specifications. Landscaping for improvement to the human environment is now included in the proposed plan to help mitigate environmental impacts in the project area and to fulfill the objectives set forth in the National Environmental Policy Act of 1969, Public Law 91-190.

61. A Cultural Resources Survey was conducted by a qualified archeologist, and it is included in the Phase I GDM. The survey reported no evidence of pre-historic occupation. There are a number of structures in the project vicinity with architectural significance; however, none will be disturbed by the proposed project. It is anticipated that a paleontologist will recover fossil specimens before construction begins. During construction a paleontologist will be called if items of fossil specimens are uncovered. This will be included in the environmental section of the specifications.

62. Beneficial Environmental Effects of the Project. The Big Creek Flood Control Project will increase the hydraulic capacity of the system to protect against the design discharge. This will prevent damaging overbank flooding. Protection from periodic flooding disruptions, in the long run, will improve the social well-being of the community by protecting the Metroparks Zoo, commercial structures, and public structures, and allowing for uninterrupted business and industry activity without temporary loss of employment. Channel improvement measures will help eliminate some mosquito and rodent habitat along the creek and adjacent swamp areas by improving flow conditions. The diversion channel will improve conditions at the trash pile area. Placing compacted earthfill on the cut slope through the trash pile and then seeding it will improve both the natural environment and the human environment.

63. Adverse Environmental Effects of the Project. Construction activity will temporarily create mud, dust, and noise; exhaust fumes produced by heavy equipment will also cause some odor. Large trucks used for hauling will be a general nuisance to local residential areas, motorists, and pedestrains. Traffic delays and disruption of normal

traffic flow will temporarily occur where roads are modified. John Nagy Boulevard and the Zoo access road will be temporarily closed while they are modified. Railroad service will be temporarily disrupted during construction of tie-ins and temporary trestle construction. There will be temporary water turbidity created by construction activity. Removal of existing vegetation will temporarily detract from the human environment provided by woody and herbaceous plants along the creek. Environmental protection measures will be provided in the specifications. Strict enforcement of these measures will help to reduce some of the adverse environmental effects of the project.

64. The project will destroy terrestrial vegetation and aquatic environment used as wildlife habitat, thereby reducing plant and animal species diversity in the immediate project area. Large shade trees along the stream banks will be destroyed. The project will also permanently substitute a natural setting with man-made construction features and destroy and disturb the stream bottom substrate together with existing associated benthic communities.

X. ACCESS ROADS AND RAILROAD FACILITIES

65. Construction Access. Access for construction operations will be on temporary haul roads adjacent to the floodway, modified, and diversion channels. Public highways will be used for movement of project materials such as riprap, bedding material, filter material, gravel drain material, concrete, reinforcing steel, earth borrow, and spoil material. Access is available to the proposed borrow and spoil areas. Off-road equipment will not be allowed to operate over public roads; and, therefore, no Federal improvement would be required as a result of this use. Officials from the City of Cleveland have indicated that the Contractor will be able to use public roads. Any limitations as to routes and time schedules will be agreed upon between the City representatives and the contractor. Until the final contract is prepared, the City will not comment on specific limitations to be imposed.

66. The existing Baltimore and Ohio Railroad facilities could also be used for movement of project materials. At the Contractor's option, with approval of the Baltimore and Ohio Railroad, the spurline could be used for this purpose. Specifically, it might be convenient for the Contractors to use the railroad facilities for movement of the various construction products associated with the construction of the railroad relocation and the railroad bridges.

67. Permanent Access. Permanent access to project features for operation and maintenance purposes will be via public highways and on earth access roadways adjacent to the improved channels. It is proposed to obtain sufficient easements to allow access on each bank of the improved channels for maintenance operations. Permanent roads would not be constructed, however, as these operations would be infrequent.

68. John Nagy Boulevard. As described previously, John Nagy Boulevard will be an integral part of the chute-transition located at the upstream end of the floodway channel. The chute-transition is designed to accommodate the normal flow of traffic, except during times of flood, when it will pass the flood discharge. Construction of the chute-transition will require that John Nagy Boulevard be temporarily closed sometime between October and May. The City of Cleveland will be responsible for traffic diversion measures. The Contractor will be allowed to use John Nagy Boulevard, upstream of the project, for access.

69. Zoo Access Road. The Zoo access road is used only infrequently by the Zoo for maintenance operations. The proposed modifications to this road are described in Section VII, Description of Proposed Structures and Improvements. As the road connects to John Nagy Boulevard at the chute-transition, it will be temporarily closed during construction of that structure. The Zoo officials are aware of the situation, which will not create significant difficulties. The proposed improvements to the road are solely to prevent floodwaters from entering the Zoo area. The Contractor will be allowed limited use of the road for access to the construction site. However, the use may be somewhat limited, so that the Contractor does not interfere with visitors to the Zoo. The Contractor will be responsible for repairing any damage which his operations may cause to the road.

XI. CONSTRUCTION MATERIALS

70. Required Materials. Earthfill will be required for the relocated railroad embankment, levee, Zoo access road, Zoo floodplain, protective cover on the trash pile, protective cover on the channel bottom, and along some reaches of the floodway and modified channels. Compacted backfill will be required in connection with concrete construction.

71. Stone will be required for riprap and for filling the wire mesh gabion baskets. Bedding material will be required in connection with riprap and gabion construction, and filter material and gravel drain material will be required in connection with the construction of concrete structures and the levee. Coarse and fine aggregate will be required for concrete.

72. Sources. Required common excavation will be used for earthfill and compacted backfill. However, because of the unsuitability of project soils, a considerable portion of required common excavation will not be useable as earthfill and compacted backfill. As a result, borrow material will be required. A considerable portion of the relocated railroad embankment will have to come from borrow. An offsite borrow area has been explored, and it was found to contain a sufficient quantity of suitable material. The location of the borrow area is shown on Plate 3, and a description of the borrow material is presented in Appendix A.

73. Stone for riprap and gabions, bedding material, filter material and gravel drain material, and coarse and fine aggrate are available from commercial suppliers in the Cleveland area. A materials survey was conducted which indicated that stone meeting the design criteria for riprap and gabions is available locally. The materials survey is included in Appendix A. Concrete, either ready mixed or unmixed, is available locally.

XII. ENVIRONMENTAL QUALITY ENHANCEMENT MEASURES

74. General. The proposed alignments of the floodway, modified, and diversion channels, and the proposed alignments of the relocated railroad mainline and spurline were set to minimize damages to existing buildings and land use to the maximum extent possible.

75. All areas disturbed during construction including levee top and side slopes, channel side slopes, channel bottom where seeded, relocated railroad embankment side slopes, earthfill at Zoo floodplain, Zoo access road side slopes, haul roads, and ditches will be seeded with a mixture designed specifically for erosion protection and improvement to the human environment.

76. The spoil area for the project is shown on Plate 3. The spoil area will be graded to prevent ponding and then seeded.

77. Landscaping. Landscaping features have been incorporated into the final plan to improve the overall human environment of the project. The only area of the project where such landscaping features can be effectively provided is along the landside (Zoo side) of the levee. The intent of the plantings is to make the levee less obtrusive. Although there are no dwellings in the project area, many homes overlook the Big Creek floodplain from the hills at the sides of the valley. In addition, the plantings will augment the human environment of the Zoo area.

78. Both natural and human environmental considerations are included in the design of the project features. Specific observations concerning each feature are presented in Appendix B. The area immediately downstream from the flume, on the right bank, had less expensive alternatives than the one selected. The selected alternative was selected on the basis of human environment considerations.

XIII. REAL ESTATE REQUIREMENTS

79. Real Estate Requirements. The Phase I GDM real estate requirements provided for a 13 acre tract between the Baltimore and Ohio Railroad and Norfolk and Western Railroad lines for the floodway channel and a 4 acre tract in the vicinity of Protector Products for the diversion channel. The land requirements did not include the temporary construction areas required, the land in the project area owned by the City of Cleveland and Metroparks, nor the lands that would remain in the ownership of the railroads.

80. The Phase II GDM real estate requirements noted herein include all of the temporary and permanent easements required for the construction of the project. A plan of the real estate requirements are presented on Plates 32 through 35, inclusive.

81. The real estate costs were increased from October 1976 to January 1979 price levels using Consumer Price Indices, All Commodities and Farmland Price Values and Indices (overall factor of increase 1.17). The temporary and permanent easement costs were considered to be 10 percent and 80 percent, respectively, of the fee simple acquisition cost. The land acquisition costs in the project area were verified (March 1979) based on the most current Cuyahoga County tax assessment (1976) evaluation of comparable land sales in the area.

82. A comparison of the Phase I GDM and Phase II GDM land acquisition requirements and costs is shown in Table 2.

TABLE 2

COMPARISON OF PHASE I GDM
AND
PHASE II GDM
LAND ACQUISITION REQUIREMENTS AND COSTS

	Land Required	Cost/Acre	Total
Phase I GDM	17 acres (fee simple)	$10,000*	$170,000
	Land Acquisition costs (10%)		17,000
			$187,000
Phase II GDM	10 acres (temporary easement)	$ 1,170**	$ 11,700
	36 acres (permanent easement)	$ 9,360**	$336,960
			$348,660
	Property Acquisition (10%±)		$ 35,340
			$384,000

* October 1976 price levels.

** January 1979 price levels.

XIV. RELOCATIONS

83. General. Implementation of the proposed project will require removals, replacements, and modifications to a railroad mainline and spurline, railroad bridges, utilities, and other miscellaneous structures. Facilities such as buildings and fence lines which are or will be abandoned will be removed at Federal expense. Proposed relocations are intended as replacements-in-kind using appropriate

criteria, and will be coordinated with the respective agencies or owners.

84. Implementation. Section 108a of Public Law 91-611 requires that non-Federal public interests agree to such items of local cooperation as the Secretary of Army deems appropriate and similar to those required for similar Federal Water Resources Projects. The items of local cooperation requires that the relocations of the railroad mainline and spurline and railroad bridges together with any utilities affected by such relocations such as sewer lines, water lines, gas and oil lines, and storm drains be provided at Federal expense. The relocations of utilities affected by the flood control plan will also be provided at Federal expense, except for overhead utility lines, which will be relocated at the expense of the local sponsor. The local sponsor will be providing the necessary lands for the construction and maintenance of the project. The design and construction of the entire flood control plan will be a Federal responsibility.

85. Railroad Relocations - Trackage. The Baltimore and Ohio Railroad mainline will be relocated to provide room for the project. The relocation will be within the limits of the proposed Big Creek Flood Control Project. Also, associated with this relocation will be the relocation of a spurline. Two new railroad bridges will be required, as discussed in Paragraphs 88 through 91, inclusive. The relocated mainline and spurline are shown on the General Plan on Plate 2 and on the Plan and Profile Drawings, Plates 4 through 7, inclusive. Relocated railroad embankment sections are shown on the typical channel sections on Plates 8 and 9. The plan and stage construction for the railroad relocations is shown on Plate 30, and the profile and typical roadbed sections are shown on Plate 31. The relocations are entirely a Federal responsibility.

86. The mainline of the Baltimore and Ohio Railroad will be relocated to more closely follow the Norfolk and Western Railroad mainline north of it, from about 200 feet east of Fulton Parkway to about 900 feet east of West 25th Street. The relocated mainline will involve 4,720 linear feet of trackage. Presently, these two lines pass through separate arches of the West 25th Street bridge. The mainline of the Baltimore and Ohio Railroad will be relocated through the same arch used for the Norfolk and Western Railroad mainline so that the second arch can be used for the diversion channel. A new bridge will be provided across the existing channel. The spurline presently serving Brookside Industrial Park passes through the

second arch. It will be replaced so as to cross the existing channel over a new bridge about 600 feet upstream from the West 25th Street bridge. The relocated spurline will involve 1,030 linear feet of trackage. The relocated spurline will tie back into the existing trackage in the industrial yard. Some alignment adjustments to the existing trackage will be required.

87. Associated with the relocation will be the removal of 5,850 linear feet of track, removal of the existing mainline bridge, and removal of some of the existing railroad embankment. Some of the railroad embankment material will be used in the construction of the channel features.

88. Railroad Relocations - Bridges. The relocation of the Baltimore and Ohio Railroad facility requires the construction of a new bridge for the relocated Baltimore and Ohio Railroad mainline, a new bridge for the relocated Baltimore and Ohio Railroad spurline, and a temporary trestle for the Norfolk and Western Railroad mainline.

89. The Baltimore and Ohio Railroad mainline structure will be a 78-foot simple span, open deck, plate girder bridge supported by semi-gravity concrete abutments founded on rock. This bridge will be constructed adjacent to an existing Norfolk and Western Railroad mainline bridge. Wingwalls on the south side of the existing structure will be removed and the abutments of the Baltimore and Ohio Railroads mainline bridge constructed so that their faces will be continuous with the faces of the existing Norfolk and Western Railroad bridge abutments. Details of the mainline bridge are shown on Plates 20 through 23, inclusive.

90. A temporary trestle will be provided on the Norfolk and Western Railroad mainline to maintain traffic during the construction of the abutments of the Baltimore and Ohio Railroad mainline bridge. The trestle consists of open deck, steel stringer spans supported by steel pile bents. On the east side, the trestle will be a single 20-foot span. On the west side, the trestle will be a four span structure, approximately 98 feet long. Details of the temporary trestle are shown on Plates 24 and 25.

91. The Baltimore and Ohio Railroad Spurline structure consists of two 76-foot simple spans. Bridge type is open deck on plate girders supported by semi-gravity abutments and a solid concrete pier. Foundations are set on rock. Details of the spurline bridge are shown on Plates 26 through 29, inclusive.

92. Property Relocations. Buildings, bridges, or fences which must be completely removed for project implementation will be accomplished as a Federal responsibility. Any necessary relocation of fences or buildings will be the responsibility of local interests. Final decision on removals or relocations will be made during the preparation of right-of-way plans necessary for project construction. The following list is exclusive of railroad structures.

Description	Approx. Location*	Proposed Alteration
Shed	Sta. 114+75F, R.B., under bridge	Remove
Animal Pen and Associated Fencing	Sta. 111+75F, R.B.	Remove
Animal Pen and Associated Fencing	Sta. 110+50F, R.B.	Remove
Animal Pen and Associated Fencing	Sta. 109+00F, R.B.	Remove
Brick Utility Building	Sta. 90+00M, R.B.	See Note Below
Abandoned Highway Bridge	Sta. 68+00D	Remove

* R.B. refers to right bank, looking downstream.

Note: At about Station 90+00M a brick utility building about 10 feet x 10 feet is located at the right bank adjacent to Suburban Industries. This building was not shown on the original topographic maps, and its existence was not known until near completion of this Design Memorandum. Verification as to whether or not this building will have to be relocated will have to be made before completion of Plans and Specifications.

93. Non-Federal Utility Relocations. The local sponsor will be responsible for the removal of the existing support system and the installation of a new support system for the electric utility pole at the diversion channel at Station 61+00D. The Owner is Cleveland Electric Illuminating (CEI). The present support system consists of two

guy wires attached to concrete anchors. The pole is not in the way of project construction, and CEI has decided that it can remain. The guy wires and concrete anchors are in the way of project construction, and they must be removed and a new anchorage system must be provided. At this writing, the new anchorage system is being designed by CEI. The new anchorage system will have to be compatible with the flood control project. The local sponsor will also be responsible for relocating the following overhead electrical utility lines:

Description	Approx. Location & Proposed Alteration
Overhead Line	Crossings near Sta. 67+90D and also extending along existing B&O Railroad embankment - CEI proposes to relocate this line outside the project limits.
Overhead Line	Sta. 113+80F - Poles to be relocated clear of chute-transition.
Overhead Line	Sta. 104+00F to Sta. 113+08F - Poles to be relocated clear of floodway.

94. Federal Utility Relocations. As part of the proposed flood control project, the following utility relocations will be a Federal responsibility.

Description	Approx. Location & Proposed Alteration
Storm Sewers	
24" VCP	Sta. 75+00M - Existing pipe to be altered in grade near channel and extended to a concrete headwall.
8" VCP	Sta. 86+50M - Same as 24" VCP, above.
Sanitary Sewers	
6" CIP	Sta. 90+00M - The outfall of the existing line will be extended through the wall of the proposed transition at the end of the three-barrel conduit.

Description	Approx. Location & Proposed Alteration
Sanitary Sewers	
4" CIP	Sta. 98+75F - A new line of the same size will be constructed parallel to the existing line and connected to the existing line with new manholes at each end.
48" Brick Overflow	Sta. 68+00D - The line presently crosses the proposed Diversion Channel. The line will be relocated to parallel the right bank of the flume. It will discharge at a head wall upstream of the flume at the right bank of the modified channel.
Water Lines	
20" CIP	Sta. 67+50D - A new line of the same size will be constructed parallel to the existing line with new valve pits at each end. As the line must be kept in service continuously, it will be necessary to construct manholes at each side of the diversion channel and jack or auger the new pipe, at the proposed diversion channel grade, under the existing B&O Railroad. The new line will be jacked under the existing N&W Railroad and cased under the proposed B&O Railroad.
8" CIP	Sta. 107+00F to Sta. 118+30F - A new 8" CIP will be constructed essentially parallel to the existing line. The alignment will be outside the floodway levee and then cross under the chute-transition. Under the chute-transition, the line will be encased in concrete.

Description	Approx. Location & Proposed Alteration
Water Lines	
4" CIP	Sta. 108+00F to Sta. 114+00F - The line is to be abandoned (See below).
6" CIP	Sta. 114+00F to Sta. 114+50F - A new 8" CIP line will be encased in concrete and extended under the Zoo access road to replace the existing line and the 4" CIP line above.
Street Lights	
Street Lights	Sta. 114+60F and Sta. 117+80F - To be relocated outside of the chute-transition.
Electric Lines	
Underground Ducts	Sta. 67+50D - To be relocated underground in essentially the same manner as the 20" CIP water line at Sta. 67+50D.
Underground Line	Sta. 113+80F L.B.* - To be deepened to clear the proposed improved road.

* L.B. Refers to left bank, looking downstream.

Telephone Lines	
66" Dia. Duct Tunnel	Sta. 67+75D - To be relocated underground in essentially the same manner as the 20" CIP water line at Sta. 67+50D. Tunneling will be required in certain areas.

Description	Approx. Location & Proposed Alteration
Gas Lines	
6" Low Pressure	Sta. 67+50D - To be relocated underground in essentially the same manner as the 20" CIP water line at Sta. 67+50D.

XV. COST ESTIMATES

95. Summary and Comparison of First Cost Estimates. A summary and comparison of the Phase I and Phase II GDM first cost estimates is presented in Table 3. The Phase I GDM first cost estimate was based on October 1976 price levels. The Phase II GDM first cost estimate was based on January 1979 price levels. The Phase I GDM first cost estimate is escalated to January 1979 price levels for comparison with the Phase II GDM first cost estimate. Details of the Phase II GDM first cost estimate are presented in Appendix E.

TABLE 3

SUMMARY AND COMPARISON OF ESTIMATED FIRST COSTS

Description	Phase I GDM October 1976 Price levels	Phase I GDM January 1979 Price levels*	Phase II GDM January 1979 Price levels
Federal Cost	$4,304,000	$4,993,000	$13,889,000
Non-Federal Cost	203,400	236,000	666,000
Total Cost	$4,507,400	$5,229,000	$14,555,000

*Escalation factor approximately 1.16.

96. Comparison of Estimates. Table 3 sets forth a summary and comparison of the Phase I and Phase II GDM estimated first costs. Comparing the Phase I and Phase II GDM costs at January 1979 price levels, the increase in the

Federal cost is $8,896,000 and the increase in the non-Federal cost is $430,000. Generally, the increase in Federal cost is due to changes in the project features and to design refinements. Changes in project features resulted because of a combination of factors. A detailed discussion on some of these factors is in the Alternative Studies presented in Appendix B. Following is a brief discussion of some of the major factors that contributed to changes in project features.

97. The Phase I GDM first cost estimate was based on the use of a USGS topographic map. An updated topographic map was used for the Phase II GDM first cost estimate. This resulted in changes that in turn increased project costs. The trash pile area was not addressed in the Phase I GDM. A considerable portion of the increase in project costs is attributed to the trash pile. Trash material is not suitable for project fill; therefore, expensive borrow material is required. Also, trash material must be spoiled at a considerable expense. Special treatment of the cut slope through the trash pile is also an added expense. The location of the spurline bridge changed and the length of the bridge increased. This resulted in an increase in the bridge cost. The length of flume increased, and a special support system is necessary at the West 25th Street bridge pier. This also increased project costs. A considerable portion of natural overburden soils at the project site will be too wet for use as fill material. This results in an increase in both spoiling costs and borrow material costs. The air-slaking characteristic of the project shale was not addressed in the Phase I GDM. Protecting the shale resulted in a considerable increase in project costs. The costs for the relocation of utilities, such as, water lines, sewer lines, and electric lines were not considered in the Phase I GDM. The costs for this work increased the project cost considerably.

98. The increase in the estimated non-Federal first cost is attributed to project property cost, project construction, utility relocation, and related cost. The Phase I GDM estimated project property cost was based on 17 acres, and the Phase II GDM is based on 46 acres. The increase in acreage results in an increase of $196,000 in project property cost. Project construction, utility relocation, and related cost increased by $234,000. The increase in costs reflects both project changes and price level changes.

99. Annual Charges. The estimated investment costs and the annual charges for the project are shown on Table 4. Annual charges on investments are derived by application of an interest rate of 5-3/8 percent for both Federal and non-Federal costs as the latter would be borne entirely by the local sponsor. Amortization rates are determined on the basis of that interest rate and an estimated project life of 50 years.

TABLE 4

ESTIMATED INVESTMENT COSTS AND ANNUAL CHARGES

Item	Federal Cost	Non-Federal Cost	Total Cost
First Cost	$13,889,000	$666,000	$14,555,000
Investment Cost			
Annual Charges			
Interest(5-3/8%)	746,500	35,800	782,300
Amortization (0.00424)	58,890	2,820	61,710
Maintenance	5,500	6,800	12,300
Total Annual Charges	$ 810,890	$ 45,420	$ 856,310

100. With proper maintenance, the project could be expected to have a more extended life; however, it cannot be confidently assumed that the present character of developments in the area will be sustained much beyond 50 years, such that the average annual benefits at the level now estimated would continue. The estimated non-Federal maintenance charges are for the maintenance requirements outlined in Section XVII, Operation and Maintenance. The Federal mainatenance charge is for annual inspection to determine that the prescribed maintenance program is being accomplished by the local sponsor and to maintain a stream gage near the site.

XVI. SCHEDULES FOR DESIGN AND CONSTRUCTION

101. Responsibility for Implementation. Implementation of the final plan will require a Section 221 Agreement, under Public Law 91-611, between the local sponsor (Cleveland Metroparks System) and the Federal Government. Property acquisitions will be the responsibility of the local sponsor. The design and construction of the floodway, modified, and diversion channels, and the railroad relocations will be a Federal responsibility. Implementation of the railroad relocations will require an agreement among the Baltimore and Ohio Railroad, the Norfolk and Western Railroad, and the Federal Government. Implementation of the utility relocations, such as, electric lines, water lines, and sewer lines, will be accomplished by agreements between the various utility companies and either the Federal Government or the local sponsor, as applicable.

102. Schedule for Design. Completion of design and preparation of plans and specifications are proceeding simultaneously with the preparation of this Phase II GDM. It is estimated that total time necessary to complete the plans and specifications for construction will be about two months.

103. Schedule for Construction. It is estimated that the construction of all the features of the project can be completed in 24 months. This period is applicable regardless of the date of Notice to Proceed. As of this writing, it is anticipated that Notice to Proceed will be on 15 April 1980.

104. The construction sequence is discussed in Paragraphs 52 and 53. The main item affecting the schedule for construction is the relocation of the Baltimore and Ohio Railroad mainline and spurline. Until the mainline and spurline railroad relocations are complete and in service, construction on the floodway, modified, and diversion channels will be limited because the existing mainline and spurline must be kept in operation. Thus, priority will have to be given to the construction of the relocated mainline and spurline. The recommended stage construction for the relocated mainline and spurline is presented on Plate 30. As soon as possible after Notice to Proceed, the Contractor will have to start construction of the embankment for the relocated mainline. The mainline embankment would be complete up to subgrade by 30 September 1980.

Construction of the Norfolk and Western Railroad trestle bents and the mainline bridge will also have to begin immediately after Notice to Proceed. The trestle bents and mainline bridge would be complete by 1 January 1981. Because it is anticipated that the Contractor would be using the top of mainline embankment as a haul road, the construction of the roadbed and trackage for the mainline would not be started until the embankment was complete. Construction of the roadbed and trackage for the mainline and the temporary spurline would therefore begin immediately after completion of the mainline embankment. This work would be complete by 15 November 1980. Connections to the existing mainline could not start until after completion of the mainline bridge. These connections would be completed by 15 January 1981, and the relocated mainline and temporary spurline would be in service by 15 January 1981.

105. Construction of the south abutment and pier of the spurline bridge would be accomplished simultaneously with the mainline bridge. The north abutment cannot be completed during this period because of the existing mainline. It would be desirable to complete as much of the concrete work on the spurline bridge as possible before the winter season. The south abutment and pier of the spurline bridge would be complete by 15 November 1980. Because the relocated mainline would not be in service until 15 January 1981, construction of the north abutment and the superstructure of the spurline bridge would have to be accomplished during the winter season. This construction would be completed by 15 March 1981. Although portions of the spurline embankment could be placed before the spurline bridge was complete, the spurline embankment cannot be completed until the abutments are complete. The spurline embankment would be complete to subgrade by 22 March 1981. Completion of the construction of roadbed and trackage would follow, and the spurline would be in service by 15 April 1981.

106. Some construction on the floodway, modified, and diversion channels can proceed simultaneously with the relocated railroad construction. Since the concrete chute-transition at the upstream end of the floodway is not affected by the railroad relocation, it would be desirable to start construction on the chute-transition as soon as possible after Notice to Proceed. Construction of the chute-transition would extend through 30 November 1980. Included with the chute-transition construction would be the access to Brookside Park Drive and part of the Zoo access road immediately adjacecent to the chute-transition. Portions of the floodway channel not affected by the

existing Baltimore and Ohio Railroad mainline would have to be constructed simultaneously with the relocated mainline embankment in order that suitable excavation materials could be utilized in the mainline embankment. Construction on portions of the floodway channel not affected by the existing mainline would therefore be accomplished between Notice to Proceed and 30 September 1980. Portions of the floodway channel affected by the existing mainline obviously cannot be constructed until the relocated mainline is complete and in service. As noted previously, the relocated mainline is scheduled to be in service by 15 January 1981. It is anticipated, therefore, that construction on portions of the floodway channel affected by the existing mainline would be accomplished between 1 April 1981 and 30 November 1981. Included in this work would be the levee and the five gabion drop structures. It is necessary to construct the levee during this period since suitable excavation materials will be used in the levee construction. Although a portion of the five gabion drop structures could be completed prior to this period, it would not be desireable to construct them piecemeal.

107. The Zoo access road and the earthfill at Zoo floodplain would be constructed between 1 April 1981 and 30 September 1981. This period coincides with the construction of portions of the floodway channel affected by the existing mainline. This is necessary since it is anticipated that suitable excavation materials from these reaches of the floodway channel will be used in the access road and earthfill at Zoo floodplain. Landscaping adjacent to the levee and Zoo access road would be accomplished at a suitable time in the fall of 1981.

108. In the modified channel, the concrete transition at the end of the three-barrel conduit is not affected by the relocated rairoad mainline; and it could be constructed at any convenient time. Since the Contractor will be involved with concrete construction at the chute-transition and mainline and spurline bridges during calendar year 1980, it would seem advisable to construct the concrete transition during calendar year 1981, with construction starting early in the spring. The concrete transition would therefore be constructed between 1 April 1981 and 30 September 1981. Portions of the modified channel not affected by the existing Baltimore and Ohio Railroad mainline would have to be constructed simultaneously with the relocated mainline embankment in order that suitable excavation materials could be utilized in the mainline embankment. This construction would be accomplished between Notice to Proceed

and 30 September 1980. There is a considerable portion of the modified channel affected by the existing mainline. The construction of this portion cannot be constructed until the relocated mainline is in service. Construction on this portion of the modified channel would be accomplished between 16 January 1981 and 30 November 1981.

109. Construction of the diversion channel is affected by both the existing Baltimore and Ohio Railroad mainline and spurline. Similar to the floodway and modified channels, portions of the diversion channel not affected by the existing railroad would be constructed simultaneously with the construction of the relocated mainline embankment in order that suitable excavation materials can be used in the mainline embankment. Although the quantity of suitable excavation materials from the diversion channel is limited, all suitable materials should be used because of the expense of borrow material. The bulk of the diversion channel excavation is trash pile material that is not suitable for use in the relocated mainline embankment and must be spoiled. However, the trash pile should still be excavated simultaneously with the construction of the relocated mainline embankment because of the location of the designated spoil area. Since the spoil area is adjacent to the borrow area (See Plate 3), in one round trip a truck load of trash material can be hauled to the spoil area and a truck load of borrow material brought back to the project. Construction of this portion of the diversion channel would therefore be performed between Notice to Proceed and 30 September 1980. Since the relocated spurline is not scheduled for completion until 15 April 1981, work on the remainder of the diversion channel could not start until after this date. Included in this work would be the construction of the flume and associated walls at the upstream end of the flume. This work would be performed between 16 April 1981 and 30 November 1981.

110. Essentially, the major components of the project would be constructed by 30 November 1981. However, it is anticipated that minor items such as seeding, final clean-up, and miscellaneous items would be delayed until spring of 1982. The project would be completed by 15 April 1982.

111. As of this writing, details concerning the relocation of utilities have not been finalized. It is anticipated that utilities affected by the project will be relocated by the Owner of the utility. It is assumed that

the schedule for the utility relocations will not be in conflict with the construction schedule for the major components of the project outlined above.

112. The schedule for construction of the major components of the project is summarized in Table 5.

TABLE 5

SCHEDULE FOR CONSTRUCTION

OF MAJOR COMPONENTS OF PROJECT

Description		Dates
Notice to Proceed		15 APR 80
Railroad Relocation		
(1)	Mainline Embankment To Subgrade	15 APR 80 to 30 SEP 80
(2)	Roadbed and Trackage Mainline; and Temporary Spurline	1 OCT 80 to 15 NOV 80
(3)	South Abutment and Pier of Spurline Bridge	15 APR 80 to 15 NOV 80
(4)	N&W Trestle and Mainline Bridge	15 APR 80 to 1 JAN 81
(5)	Connections to Existing Mainline	2 JAN 81 to 15 JAN 81
(6)	Relocated Mainline and Temporary Spurline Completed and in Service	15 JAN 81
(7)	North Abutment and Superstructure of Spurline Bridge	16 JAN 81 to 15 MAR 81
(8)	Spurline Embankment to Subgrade	15 APR 80 to 22 MAR 81
(9)	Roadbed and Trackage, Spurline	1 MAR 81 to 1 APR 81
(10)	Connections to Existing Mainline	2 APR 81 to 15 APR 81

TABLE 5

SCHEDULE FOR CONSTRUCTION

OF MAJOR COMPONENTS OF PROJECT (CONT'D.)

Description	Dates
(11) Spurline Completed and in Service	15 APR 81
Floodway Channel	
(1) Chute-Transition	15 APR 80 to 30 NOV 80
(2) Portions of Channel Not Affected by Existing Mainline	15 APR 80 to 30 SEP 80
(3) Portions of Channel Affected by Existing Mainline (Includes Levee and Drop Structures)	1 APR 81 to 30 NOV 81
Zoo Access Road and Earthfill at Zoo Floodplain	1 APR 81 to 30 SEP 81
Landscaping at Levee and Zoo Access Road	1 OCT 81 to 15 NOV 81
Modified Channel	
(1) Portions of Channel Not Affected by Existing Mainline	15 APR 80 to 30 SEP 80
(2) Portions of Channel Affected by Existing Mainline	16 JAN 81 to 30 NOV 81
(3) Transition at Three-Barrel Conduit	1 APR 81 to 30 SEP 81
Diversion Channel	
(1) Portion of Channel Not Affected by Existing Mainline and Spurline	15 APR 80 to 30 SEP 80
(2) Portion of Channel Affected by Existing Mainline and Spurline, Flume, and Walls at Upstream End of Flume	16 APR 81 to 30 NOV 81

113. Funding Requirements. Project cost estimates prepared during this Phase II GDM effort are presented in Appendix E. Based on January 1979 price levels, the estimated Federal first cost is $13,889,000 and the estimated non-Federal first cost is $666,000. Based on the schedule for construction presented in Paragraphs 103 through 111, inclusive, and on the project cost estimates, an estimate was made of the Federal Construction funds required by fiscal year. This estimate is presented in Table 6. The funds include 15 percent contingencies but do not allow for engineering & design and supervision & administration. Federal costs for utility relocations are included. Non-Federal costs are not included.

TABLE 6

FEDERAL CONSTRUCTION FUNDS REQUIRED BY FISCAL YEAR

Fiscal Year	Federal Construction Funds Required
FY 80	$ 4,304,000
FY 81	6,358,000
FY 82	911,900
Total	$ 11,573,900

114. Proposed Plan of Operation. There are no operating mechanisms for the proposed flood control project. However, there are flap gates that should be inspected and lubricated a minimum of once a year and repaired as necessary to insure their operating efficiency. Upon completetion of the proposed flood control project, an operations and maintenance manual will be provided to the local sponsor.

115. Proposed Plan of Maintenance. Maintenance will include: shoal removal; embankment repair; riprap replacement or resetting; gabion wire basket repair; cutting vegetative growth on berms, levees, channel bottoms, and channel side slopes; flap gate inspection and maintenance; and channel clearing and sediment and debris removal. As part of the normal maintenance operation, the two-barrel conduit and three-barrel conduit will be cleared of sediment and debris. Also, as part of the normal maintenance operations, all headwalls and drain openings are to be kept free

from ice and debris; and the manholes for the subdrainage system of the chute-transition are to be inspected and cleared of any sediment and debris.

116. Representatives of the Corps and the Metroparks Zoo will make annual inspections. Reports on the status of maintenance will be prepared, and the Metroparks Zoo will accomplish any maintenance required in compliance with the assurance agreement.

117. Major Replacements. The anticipated useful life of the proposed flood control project is 50 years. With proper maintenance, the channels can be expected to have a more extended life. The major structures have an estimated useful life of 50 years; and, therefore, no major replacements are anticipated during the estimated project life.

118. Annual Operation and Maintenance Costs. The annual operation and maintenance described above is estimated to cost $6,800 at January 1979 price levels. This cost would be borne by the local sponsor. The estimated annual Federal cost for inspection and reports is $500. The $5,000 average annual cost for maintaining the stream gaging station along Big Creek shall be a Federal responsibility of this Project.

XVIII. BENEFITS

119. Benefits. The Phase I GDM (November 1977) provides a detailed account of the planning, criteria, and methodology used in developing the projects benefits. The benefit categories developed and presented in the Phase I GDM were: Flood Damage Reduction, Land Use Intensification, and Area Redevelopment. The estimates of these average annual benefits were updated to reflect January 1979 price levels as shown in Table 7.

TABLE 7

ESTIMATED AVERAGE ANNUAL BENEFITS

Benefit Category	Average Annual Benefit Phase I GDM October 1976 Price Levels	Average Annual Benefit Phase II GDM January 1979 Price Levels
Flood Damage Reduction	$276,800	$323,600
Land Use Intensification	410,500	480,300
Area Redevelopment	41,800	137,100
Total	$729,100	$941,000

The increase in benefits noted above is attributed entirely to price level changes; consequently, a discussion of the individual benefit categories has not been included in this report. The Area Redevelopment benefits were escalated using the current project construction cost estimate.

120. The remaining project benefits noted above were increased in compliance with ER 1105-2-352 (Economic Consideration: Updating Project Benefits). The "Benefit Category and Source" indices from Appendix A of ER 1105-2-352 for increasing the Flood Damage Reduction and Land Use Intensification benefits were "Control of Water Damage, Industrial Structures" (CWDIS) and "Recreation and Fish and Wildlife" (RGSFW) respectively. These categories were selected as the project inundation reduction benefits are attributable entirely to Industrial Structures in the project area, and the land use intensification benefits were derived from the projected increase in Zoo attendance as a result of the project. Indices for updating project benefits are shown in Table 8.

TABLE 8

INDICES FOR UPDATING PROJECT BENEFITS

Benefit Category	A Oct. 1976 Value	B Jan. 1979 Value	C B/A	D Weighting Factor	E CxD
(1) Flood Damage Reduction					
Control of Water Damage, Industrial Structures					
Index Sources:					
ENR, Construction	2478.2	2877.5	1.16	.5	.580
ENR, Building	1475.8	1740.4	1.18	.4	.472
Wholesale Price All Commodities	185.2	217.4	1.17	.1	.117
			Total		1.169
(2) Land Use Intensification					
Recreation & Fish & Wildlife					
Index Sources:					
Consumer Price, All Items	173.3	202.9	1.17	.8	.936
Wholesale Price All Commodities	185.2	217.2	1.17	.2	.234
			Total		1.17

121. The total estimated average annual benefits are $941,000 at January 1979 price levels. This is an increase of 27 percent over the Phase I GDM estimate. The increase is attributable to inflation and revisions in the estimated construction cost.

XIX. COST ALLOCATION

122. Cost Allocations. In return for anticipated benefits from reduction of flood damages, the local sponsor will be required to provide lands and perform or compensate Federal interests for relocation works which come within the purview of the items listed in Paragraph 2.

123. Non-Federal property and construction cost for the project as shown in Appendix E on Table E5 would be comprised of $348,660 for property and $235,000 for relocation works. Including 10% for property acquisition costs, the total non-Federal property cost would be $384,000, as shown in Table E1. Including 11% for Engineering and Design and 9% for Supervision and Administration, the total non-Federal construction cost would be $282,000, as shown in Table E1. The total non-Federal cost is $666,000. The total estimated first cost for the required local cooperation does not exceed the estimated Federal first cost of $13,889,000.

XX. BENEFIT-COST RATIO

124. Benefit-Cost Ratio. A comparison of the estimated average annual benefits of $941,000 and the estimated average annual costs of $856,340 gives a benefit-cost ratio of 1.10. The average annual benefits are adjusted to include land use intensification and area development factors. The average annual costs are based on a 50-year economic life and interest rate of 5-3/8 percent. The Big Creek Flood Control Project has a benefit-cost ratio of 0.38 when only existing average annual benefits are used.

XXI. STATEMENT OF FINDINGS

125. Statement of Findings. Studies for this General Design Memorandum have established that flood problems in

the Big Creek watershed are largely concentrated near the Metroparks Zoo where occupation of areas subject to flooding, mainly by the Zoo and nearby industries, is virtually complete. Outside the area, the areas subject to flooding are either not as highly developed or contain developments of types not subject to appreciable permanent damage.

126. The magnitude of the flood damage to which the Zoo and the adjacent area is susceptible easily warrants consideration of protective works for the community. Protection must consist of local physical improvements since feasible alternative solutions to the flood problem are lacking. The most suitable plan is presented in this General Design Memorandum. A general plan of the most suitable plan is shown on Plate 2.

127. It has been established that existing flood damages in the upstream and downstream areas are presently insufficient to justify structural improvements. Proper application of the data in the Flood Plain Information Report, however, can guide individuals and local agencies in planning uses which are compatible with the flood threat. Local interests are taking advantage of this information and the technical assistance available through the Corps of Engineers Floodplain Management Services.

128. The proposed plan is economically feasible based upon a benefit-cost ratio of 1.10. Total first cost is estimated to be $14,555,000 of which $666,000 would be borne by non-Federal interests as local cooperation. The local sponsor will be required to furnish lands necessary for the project. They will also be required to maintain the project.

129. In determining the Selected Plan, means of eliminating, minimizing or ameliorating possible adverse environmental, social and economic effects were considered. Where the proposed action has an adverse effect, the effect is substantially outweighed by other objectives and considerations of national policy. In light of these findings, the plan recommended in this General Design Memorandum should be implemented to serve the public interests.

XXII. ENVIRONMENTAL IMPACT STATEMENT

130. Environmental Impact Statement. As described in Section IX, Environmental Analysis, a Final Environmental Impact Statement (FEIS)has been filed for the project. The FEIS was amended with a Clarification Statement, as described in Section IX. A copy of the Clarification Statement is included in the Attachments Section of this Phase II GDM. There are no significant changes to the FEIS as amended, and there is no known opposition to the conclusions of the FEIS as amended.

XXIII. RECOMMENDATIONS

131. Recommendations. I recommend that the Project Plan presented in this Memorandum be approved and implemented providing the local sponsor enters into an agreement pursuant to Section 221 of Public Law 91-611 containing the items of local cooperation in Paragraph 2.

GEORGE P. JOHNSON
Colonel, Corps of Engineers
District Engineer

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

PHASE II
GENERAL DESIGN MEMORANDUM

ATTACHMENTS

CONTENTS

Kelley, McCann & Livingstone

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MARGARET A. FOSTER
STEVEN N. BULLOCH
JUDITH HARRIS RAWSON

August 28, 1978

Colonel Daniel Ludwig
District Engineer
U. S. Army Corp of Engineers
1776 Niagara Street
Buffalo, New York 14207

Re: Cleveland Metropolitan Park District -
Big Creek Flood Control Project

Dear Colonel Ludwig:

The undersigned is legal counsel for the Board of Park Commissioners of the Cleveland Metropolitan Park District, Cleveland, Ohio and this firm has represented the Park District for over 60 years.

In connection with the Big Creek Flood Control Project, and the agreement to be entered into between the Park District as the local cooperating agency, and the Federal Government, it is my opinion tnat the Board of Park Commissioners of the Cleveland Metropolitan Park District is a legally constituted public body with full authority and capability to perform the terms of its agreement and to pay damages if necessary in the event of failure to perform.

The Cleveland Metropolitan Park District was the first park district to be created in the State of Ohio pursuant to Ohio Revised Code, Chapter, 1545. This legislation has been reviewed and upheld by the Supreme Court of Ohio. The Supreme Court has further held that such a park district is a political subdivision of the State of Ohio performing a governmental function of the State. The capacity to contract is one of the essential attributes of such a political subdivision.

Under the statute, the Board of Park Commissioners is a body politic and corporate and may sue and be sued (§1545.07

Ohio Revised Code). It is given broad powers to "develop, improve, protect and promote the use of" park lands "in such manner as the Board deems conducive to the general welfare" (§1545.11 Ohio Revised Code).

The Board of Park Commissioners of the Cleveland Metropolitan Park District has previously entered into cooperative agreements with the Federal Government in connection with the dredging of Rocky River and with the State of Ohio in a number of instances.

If further information in connection with this matter is required, please do not hesitate to let me know.

Sincerely,

Walter C. Kelley

WCK/mm

cc: Mr. Harold Schick

DEPARTMENT OF THE ARMY
NORTH CENTRAL DIVISION, CORPS OF ENGINEERS
536 SOUTH CLARK STREET
CHICAGO, ILLINOIS 60605

NCDRE-A

13 DEC 1978

SUBJECT: Big Creek Flood Control Project - Authority of Cleveland Metropolitan Park District to Act as Sponsor

District Engineer, Buffalo

1. The authority of the Cleveland Metropolitan Park District to act as sponsor of subject project has been reviewed and the affirmative opinion of the Attorney for the Park District regarding said subject has been received.

2. Based on the foregoing it is considered that the Cleveland Metropolitan Park District has the requisite authority under Section 221 of Public Law 91-611 to act as Sponsor of the Big Creek Flood Control Project.

FOR THE DIVISION ENGINEER:

J. D. GORDON
Acting Chief, Acquisition Branch
Real Estate Division

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BIG CREEK FLOOD CONTROL PROJECT, CLEVELAND, OHIO. PHASE II. GEN--ETC(U)
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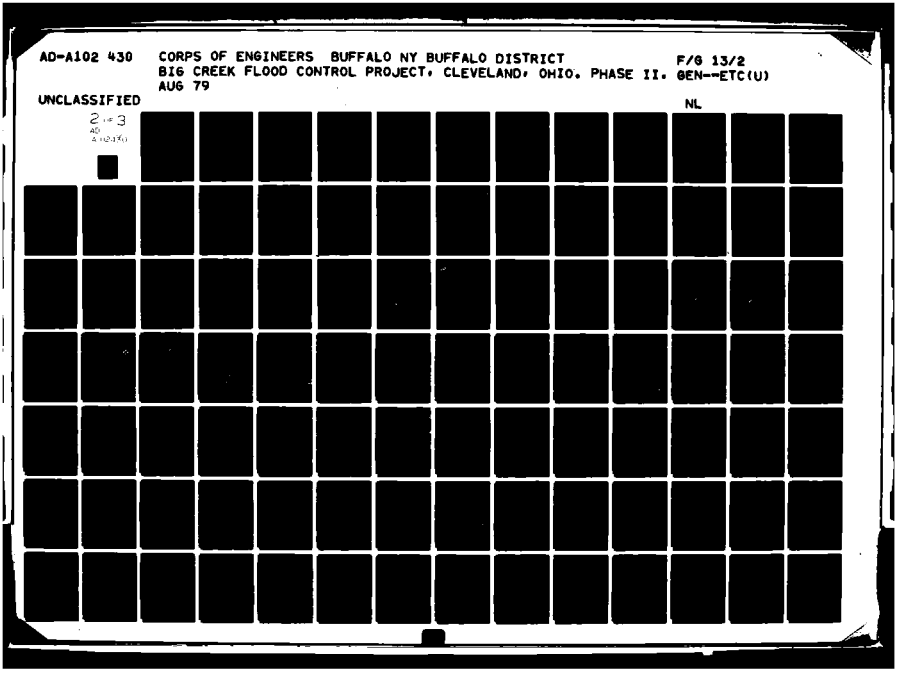


BIG CREEK WATERSHED
FLOOD PROTECTION
CLEVELAND, OHIO

GENERAL DESIGN MEMORANDUM
PHASE I

ATTORNEY'S REPORT

1. Project: A project for flood control and other environmental purposes for the Cuyahoga River Basin (of which Big Creek is a part) was authorized by Section 108 of the River and Harbor Act of 1970, Public Law 91-611; 84 Stat. 1818. The authorization states:

> (a) "The Secretary of the Army, acting through the Chief of Engineers, is authorized to investigate, study, and undertake measures in the interests of water quality, environmental quality, recreation, fish and wildlife, and flood control, for the Cuyahoga River Basin, Ohio. Such measures shall include, but not be limited to, clearing, snagging, and removal of debris from the river's bed and banks; dredging and structural works to improve streamflow and water quality; and bank stabilization by vegetation and other means. In carrying out such studies and investigations the Secretary of the Army, acting through the Chief of Engineers, shall cooperate with interested Federal and State agencies.
>
> (b) Prior to initiation of measures by this section, such non-Federal public interests as the Secretary of the Army, acting through the Chief of Engineers, may require shall agree to such conditions of cooperation as the Secretary of the Army, acting through the Chief of Engineers, determines appropriate, except that such conditions shall be similar to those required for similar project purposes in other Federal water resources projects."

In addition, as set out in the General Design Memorandum, the Assistant Secretary of the Army, by letter dated 25 September 1975, advised appropriate committees of Congress that he would

exercise authority given him by the 1970 Act and implement a plan providing for a flood protection project in the vicinity of the Cleveland zoo.

2. Local Interest: The sponsor of the project will be Cleveland Metroparks. The local sponsor will be required to provide the basic "a, b, c assurances" as set out in paragraph 31 Recommendation of the General Design Memorandum which include in part:

> provide without cost to the United States all relocations of buildings, utilities, highway and highway bridges necessary for construction of the project, except relocations of utility lines passing through or under the proposed channel, considered to be integral parts of the channel improvements within the rights-of-way of the project and, accordingly, items of Federal cost;

The assurances also included are the requirements of Section 221 of the Flood Control Act of 1970, Public Law 91-611, and of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public Law 91-646.

3. Right of Way: It is the obligation of the local sponsor, in this case, the Cleveland Metroparks, to provide all lands, easements and rights-of-way necessary for the project. Information on all the right-of-way satisfactory to the District will be furnished before construction on any segment may begin. It will be necessary for the United States to enter into construction agreements with the Baltimore and Ohio Railroad Company for the relocation of its railroad bridge and the relocation of the spur line to another location and a new bridge.

4. Relocations: A new bridge will be constructed for the Baltimore and Ohio Railroad Company, a Maryland Corporation, on a new alignment and a new bridge will be constructed to permit the relocation of the spur track to the Brookside Industrial Park. An examination of the right-of-way maps of the Railroad Company and a review of information obtained from the Cuyahoga County public records indicates that the Baltimore and Ohio Railroad Company owns either a fee or easement interest in its right-of-way. Either estate is such an interest in real estate as to entitle it to any necessary compensation for the relocation of its bridge and trackage due to the project. The General Design Memorandum sets out this work as being a Federal expense. Authority for the work is contained in Section 3 of the Flood Control Act approved July 24, 1946, 60 Stat. 642 (33 U.S.C. 701p).

Utility relocations may also be required. Those that are not integral parts of the project will be at local expense as well as the right-of-way. The integral utility relocations to be performed at Federal expense will also have the right-of-way obtained by the local sponsor.

Details of the utility relocations are not known at this time. However, in my opinion, it may not be necessary to make detailed investigation of the interest of utility, whether it is located on an easement, permit, license or any other right. It has been the position in the past that some limited type of right, such as a permit that could be terminated upon 60 days notice, gave the utility no interest in the real estate and thus no interest in the compensation. Section 302(b)(1) of Public Law 91-646 provides:

> For the purpose of determining the just compensation to be paid for any building, structure, or other improvement required to be acquired by subsection (a) of this section, such building, structure, or other improvement shall be deemed to be a part of the real property to be acquired notwithstanding the right or obligation of a tenant, as against the owner of any other interest in the real property, to remove such building,structure, or improvement at the expiration of his term, and the fair market value which such building, structure, or improvement contributes to the fair market value of the real property to be acquired, or the fair market value of such building, structure, or improvement for removal from the real property, whichever is the greater, shall be paid to the tenant therefor.

The tenant-owner of fixtures upon property has a constitutionally protected right to compensation for the value of that property which, but for the acquisition or appropriation, of the fee interest, would have reasonably continued through its useful life. Almata Farmers Elevator and Warehouse Co. v. U.S. 409 U.S. 470, 93 S Ct. 791 (1973). It has also been held

that a state agency must compensate the owners of "illegal" signs under Section 302 even though the owners had not acquired state permits. The inequities produced by a strict application of traditional eminent domain laws have been removed. Whitman v. State Highway Commission of Missouri, 400 F. Supp. 1050 (1975). It would appear that utilities could be defined as a "structure" or "improvement," and therefore can be a proper subject for relocation.

George R Wissing

GEORGE R. WISSING, Attorney
U. S. Army Engineer Division
North Central
Rock Island Real Estate Field Office
Rock Island, Illinois

12 February 1979

Contract No. DACW49
(Negotiated)

CONTRACT FOR RELOCATION AND ALTERATION OF FACILITIES

OWNER AND ADDRESS:	The Baltimore and Ohio Railroad Company P.O. Box 1800 Huntington, W. VA 25718
COOPERATING RAILWAY	Norfolk and Western Railway Company P.O. Box 6119 Cleveland, OH 44101
CONTRACT FOR:	Relocation and Alteration of Railroad Bridge and Tracks
LOCATION:	Big Creek, Cleveland, OH
AUTHORITY:	River and Harbor Act of 1970, approved 31 December 1970 (Section 108, Public Law 91-611), as implemented by Assistant Secretary of the Army letter of 27 September 1975 to U.S. Congress

CONTRACT FOR RELOCATION AND ALTERATION OF FACILITIES

THIS CONTRACT, entered into this _____ day of _____ 1979, between the UNITED STATES OF AMERICA (hereinafter called the "Government"), represented by the Contracting Officer executing this contract; and the BALTIMORE AND OHIO RAILROAD COMPANY, a corporation organized and existing under the laws of the State of Maryland (hereinafter called "Owner" or "Contractor"); and NORFOLK AND WESTERN RAILWAY COMPANY, a corporation organized and existing under the laws of the State of Virginia (hereinafter called "Norfolk" or "Contractor");

WITNESSETH THAT:

WHEREAS, the Government, has under authority of Section 108 of Public Law 91-611, approved 31 December 1970, undertaken the development of a flood protection project known as Big Creek Watershed, Cleveland, Ohio, Flood Protection (hereinafter called the "Project"): and

WHEREAS, the Owner is the holder of certain interests in land on which the Owner has constructed and is operating and maintaining certain facilities consisting of a railroad bridge designated as No. 107 and trackage, including a spur track at Brookside Park Driveway, which will be affected by construction of the Project by the Government and the maintenance and operation of the Project by the Cleveland Metropolitan Park District; and

WHEREAS, Norfolk is the holder of certain fee title in land and has certain rights of way, parts or parcels of which will be needed to relocate, alter, and construct the Owner's facilities because of construction, maintenance, and operation of the Project; and

WHEREAS, under the aforesaid authorizing Act, non-Federal public interests are required to furnish conditions of cooperation similar to those required for comparable purposes in other Federal water resources projects, as the Secretary of the Army, acting through the Chief of Engineers, determines appropriate; and

WHEREAS, Cleveland Metropolitan Park District, a legally constituted public body organized and existing under the laws of the State of Ohio (hereinafter called the "Local Assurer"), has agreed to assume the obligations of non-Federal public interests and, among other items of cooperation, will provide at no cost to the Government all lands, easements, and rights of way, as may be required for the Project; and

WHEREAS, it is necessary in the construction by the Government and enjoyment by non-Federal interests of said Project that the aforementioned title, rights and privileges of the Owner and Norfolk be modified and restricted and that said facilities of the Owner be relocated and altered; and

WHEREAS, the Owner is willing to convey or subordinate to the Local Assurer all of its right, title and interest in and to its lands and rights of way affected by the Project, in consideration of the fulfillment by the Government of the obligations hereinafter set forth; and the Owner agrees that said consideration constitutes full, just and complete compensation for the relocation and alteration and for the conveyance or subordination of its rights and property; and

WHEREAS, in consideration of the Government's construction of the Project and its enjoyment by the public, and such other consideration as may be furnished by the Local Assurer and/or the Owner, Norfolk agrees to provide the Owner those parts or parcels of Norfolk's lands, easements, and rights of way necessary to accommodate the relocation and alteration of the Owner's facilities; and

WHEREAS, the Local Assurer as part of the conditions of local cooperation for the Project, will acquire and furnish to the Owner any lands, easements, and rights of way not otherwise provided by Norfolk, and considered necessary for the relocation and alteration of the Owner's facilities; and

WHEREAS, the Owner and Norfolk have agreed to review plans, specifications, and designs prepared by the Government, and to provide yardmen, brakemen, flagmen, or watchmen as required by applicable railroad safety standards and operational requirements during the relocation and alteration work and, as necessary, during construction of the new railroad bridges.

NOW, THEREFORE, in consideration of the faithful performance of each party of the mutual covenants and agreements hereinafter set forth, it is mutually agreed as follows:

Article 1. Obligations of the Owner and Norfolk. The Owner and Norfolk shall be responsible for the following:

a. Review all designs, drawings, maps, and specifications furnished by the Government and make any comments to the Government within 60 calendar days after receipt of those documents. Failure to comment timely shall be regarded as concurrence.

b. Provide the Government's construction contractor such yardmen, brakemen, flagmen, or watchmen as may be required in accord with railroad safety regulations and operational requirements as approved by the Government, during the relocation and alteration of the Owner's facilities and, if necessary, during construction of the two new railroad bridges for the Owner. The Government's construction contract for the Project shall require that contractor, upon receipt of bills therefor and acceptance by the Government, to directly reimburse the Owner and Norfolk, as appropriate, for all actual costs of providing the above-mentioned services and for inspection by the Owner at such times as relocation and alteration work and bridge construction are being accomplished. These costs shall include applicable surcharges of the railroads, subject to Government approval.

c. Coordinate with the Government's construction contractor to minimize interruptions of railroad service during the relocation and alteration of the Owner's and Norfolk's facilities, including construction of new bridges for the Owner's main line and spur track, and temporary trestles along the Norfolk line to facilitate bridge construction.

d. The Owner shall convey or subordinate to the Local Assurer by good and sufficient deed or other instrument, all its right, title, and interest in and to its lands and rights of way affected by the Project, indicated on drawings referred to in Article 2a hereof and marked Exhibit A, and deliver to the Local Assurer releases from all liens and encumbrances on the Owner's right, title, and interest so conveyed or subordinated. This will be effected by separate transaction(s) between the Owner and the Local Assurer.

e. Norfolk shall convey or subordinate to the Owner by good and sufficient deed or other instrument, all its right, title, and interest in and to its lands and rights of way affected by the relocation and alteration of the Owner's facilities and construction of new railroad bridges for the Owner, as indicated on the drawings referred to in Article 2a hereof and marked Exhibit B, and deliver to the Owner releases from all liens and encumbrances on Norfolk's right, title, and interest so conveyed or subordinated. This will be effected by separate arrangements and documents between Norfolk and the Owner. The Owner and/or Local Assurer shall pay Norfolk the fair market value for the property to be conveyed pursuant to this paragraph.

Article 2. Obligations of the Government. - Subject to the availability of funds, the Government shall:

a. Furnish all services, labor, materials, tools, and equipment necessary to perform the relocation and alteration of the Owner's facilities, and the construction of two new railroad bridges as shown on the drawings designated as Exhibits A, B, and C, attached and made a part hereof. The Government's construction contractor will be required to exert all reasonable effort to install the temporary trestles within one work day so as to minimize delay to Norfolk's railway operations. This work will be scheduled for a date satisfactory to Norfolk and the Government's construction contractor. Work to be done by Government construction contractor may be revised by change orders issued by the Contracting Officer.

b. Make such necessary surveys and prepare such drawings, schedules, and specifications in connection with the work to be performed hereunder as may be required. Drawings, maps, or specifications furnished by the Government shall be subject to review and comment by the Owner and Norfolk, before any work to which they relate is performed; however, the Government shall have the right of final approval of those documents.

c. The Government's construction contractor shall give notice to the Owner or to Norfolk, as specified below, at least 48 hours before proceeding with work on property of the Owner or Norfolk and shall comply with instructions of the respective Railroads concerning safety:

(1) Notice to Owner:
Mr. A. M. Schuh
39 South Main Street, Akron, OH 44308
Telephone: A/C (216) 253-5299, ext. 206

(2) Notice to Norfolk:
Mr. W. M. Snow, Regional Engineer
Norfolk and Western Terminal Building
P.O. Box 6119, Cleveland, OH 44113
Telephone: A/C (216) 621-9000, ext. 261

d. The Government's construction contractor shall be required to procure and maintain during the period of performing the work specified herein, the following minimum insurance:

(1) For the Owner: Railroad Protective Insurance Policy, naming the Owner as insured, to be in the form specified in the FHPM, Volume 6, Chapter 6, Section 2, subsection 2 of the FHWA, dated 25 October 1974, and amendments thereto. The policy shall have limits of liability of two (2) million dollars per occurrence for bodily injury, death, and property damage. This insurance shall be with a company authorized to do business in the State of Ohio.

(2) For Norfolk: Railroad Protective Insurance Policy, naming Norfolk as insured, to be in the form specified in the FHPM, Volume 6, Chapter 6, Section 2, subsection 2 of the FHWA, dated 25 October 1974, and amendments thereto. The policy shall hvae limits of liability of two (2) million dollars per occurrence for bodily injury, death, and property damage. This insurance shall be with a company authorized to do business in the State of Ohio.

Prior to commencement of work hereunder, the Government's construction contractor shall be required to furnish to each railroad (Owner and Norfolk) copies of the above-required insurance with a minimum of thirty days advance notice of cancellation.

Article 3. Salvage. - The Government shall use such materials, equipment, and supplies from the facilities existing as of the date of this contract as can be placed in the facilities to be relocated, rearranged, altered, or constructed under the terms of this contract. Any existing materials, equipment, and supplies, or any part thereof, not so used, may be abandoned in accordance with the procedures set forth below.

a. If, in the opinion of the Contracting Officer, the existing facilities to be abandoned will not interfere with the construction, operation, and maintenance of the Project, then such facilities need not be removed by the Government, but may be left in place in a condition satisfactory to the Contracting Officer.

b. If, in the opinion of the Contracting Officer, the existing facilities to be abandoned will interfere with the construction, operation, and maintenance of the Project, such facilities shall be removed and disposed of by the Government.

Article 4. Betterments. - The Owner agrees that the relocation alteration, and bridge construction to be accomplished under this contract will provide the Owner with facilities equal in service and utility to those now in existence and that if the Owner desires any improvement in design, construction, or capacity over and above what is required to provide facilities of equal service or utility, such improvement shall constitute a betterment and will be paid for by the Owner; provided, however, that the term "Betterments" will not be deemed to include more costly construction or design necessitated solely as a result of the relocation, alteration, and construction.

Article 5. Ownership and Conduct of the Work.

a. The facilities constructed hereunder shall be the property of the Owner.

b. The Government construction contractor shall reduce to the extent practicable, interference with the normal operations of the Owner and Norfolk during the course of the work.

c. The Owner and Norfolk shall not commit or permit any act which may interfere with performance of any work by the Government and/or any Government construction contractor.

Article 6. Inspection and Acceptance. The Owner shall have the right to inspect the work to be performed hereunder at any reasonable time during its progress and to make final inspection upon completion thereof. Failure of the Owner to either inspect or object within 20 calendar days after final completion shall indicate satisfactory performance of the contract by the Government.

Article 7. Deferred Construction.

a. It is recognized that the Owner's facilities relocated and altered, and the new bridge construction provided for herein, may be subject to consolidation of the embankment, settlement or failure in the foundation, and the development of other conditions before the work to be performed herein has stabilized. Therefore, in addition to other costs under this contract, the Government will pay the Owner, subject to the availability of funds, the reasonable costs and expense of work actually performed by the Owner in remedy of, or in the prevention of, the conditions described herein, over and above ordinary maintenance, for a period not to exceed five (5) years after such relocated line has been placed in operation. The beginning of this period shall be determined by the Owner and the Government at a joint inspection held promptly after notice from the Government to the Owner that the work specified in Article 2, above, is completed.

b. These deferred construction costs shall include, but are not limited to costs for restoration of the roadbed by the removal or placement of grading materials, temporary, and final ballast; installation of drains, remedial work on bridges, culverts, signals, signal lines, and other facilities; realignment and resurfacing of tracks; adjustment of approach structures; and all overhead charges properly allocable to the work; all as may be necessary to remedy or prevent the described conditions, occurring singly or in combination during the specified five-year period. Such costs shall be paid by the Government only on a reimbursable basis.

c. Except in cases where the safety or continuity of train operations over the relocated line are involved, the Owner shall submit for the approval of the Contracting Officer a description of the work proposed to be done and an estimate of the cost thereof, not less than thirty (30) days prior to starting such work. When continuity of train operation or safety is involved, the Owner may proceed with the deferred construction work and immediately notify the Contracting Officer.

d. To the extent that any of the relocated and altered work or new construction, specified in this contract, causes Norfolk's existing, adjacent railroad facilities to be affected by any of the conditions mentioned in subparagraph "a" of this "Deferred Construction" clause, the provisions of that clause shall apply to Norfolk.

Article 8. Interference. The Owner and Norfolk agree that, so long as the project is operated or maintained for the purpose as described herein, the facilities as relocated, rearranged or altered pursuant to this contract shall not be so further altered or modified nor other facilities constructed by the Owner or Norfolk, so as to interfere with the operation of the Project.

Article 9. Release. The Owner agrees, on completion of the relocation, alteration, and bridge construction provided for herein, to accept said substitute facilities as full and just compensation for any and all damages that have been caused to the facilities altered and relocated hereunder and does hereby release the Government from any and all causes of action, suits at law or equity or claims or demands, and from any liability of any nature whatsoever for or on account of any damages to said rights of way and facilities relocated or altered hereunder.

Article 10. Condemnation. Should it be determined for any reason that the right, title, and interest of the Owner and Norfolk in and to the lands referred to in Article 1, above, shall be acquired by condemnation, or other judicial proceedings, the Owner and Norfolk shall cooperate in the prosecution of the proceedings and this agreement shall, without more, constitute a stipulation which may be filed in the proceedings and be final and conclusive evidence of the proper award to be made in such proceedings. In the event this contract is filed in such proceedings, it shall constitute an appearance and waiver of all rights to service or summons or other process, and the right to appointment of commissioners or a jury to determine the award.

Article 11. Disputes (1964 Jun). Except as otherwise provided in this contract, any dispute concerning a question of fact arising under this contract which is not disposed of by agreement shall be decided by the Contracting Officer, who shall reduce his decision to writing and mail or otherwise furnish a copy thereof to the Contractor. The decision of the Contracting Officer shall be final and conclusive unless within 30 days from the date of receipt of such copy, the Contractor mails or otherwise furnishes to the Contracting Officer a written appeal addressed to the head of the agency involved. The decision of the head of the agency or his duly authorized representative for the determination of such appeals shall be final and conclusive. This provision shall not be pleaded in any suit involving a question of fact arising under this contract as limiting judicial review of any such decision to cases where fraud by such official or his representative or board is alleged: Provided, however, that any such decision shall be

final and conclusive unless the same is fraudulent or capricious or arbitrary or so grossly erroneous as necessarily to imply bad faith or is not supported by substantial evidence. In connection with any appeal proceeding under this clause, the Contractor shall be afforded an opportunity to be heard and to offer evidence in support of his appeal. Pending final decision of a dispute hereunder, the Contractor shall proceed diligently with the performance of the contract and in accordance with the Contracting Officer's decision.

Article 12. Covenant Against Contingent Fees (1958 Jan). The Contractor warrants that no person or selling agency has been employed or retained to solicit or secure this contract upon an agreement or understanding for a commission, percentage, brokerage, or contingent fee, excepting bona fide employees or bona fide established commercial or selling agencies maintained by the Contractor for the purpose of securing business. For breach or violation of this warranty, the Government shall have the right to annul this contract without liability or in its discretion, to deduct from the contract price or consideration, or otherwise recover, the full amount of such commission, percentage, brokerage or contingent fee.

Article 13. Officials Not to Benefit (1949 Jul). No member of, or delegate to Congress, or resident commissioner, shall be admitted to any share or part of this contract, or to any benefit that may arise therefrom; but this provision shall not be construed to extend to this contract if made with a corporation for its general benefit.

Article 14. Gratuities (1952 Mar).

a. The Government may, by written notice to the Contractor, terminate the right of the Contractor to proceed under this contract if it is found, after notice and hearing by the Secretary or his duly authorized representative, that gratuities (in the form of entertainment, gifts, or otherwise) were offered or given by the Contractor, or any agent or representative of the Contractor, to any officer or employee of the Government with a view toward securing a contract or securing favorable treatment with respect to the awarding or amending, or the making of any determinations with respect to the performing of such contract; provided, that the existence of the facts upon which the Secretary or his duly authorized representative makes such findings shall be in issue and may be reviewed in any competent court.

b. In the event this contract is terminated as provided in paragraph (a) hereof, the Government shall be entitled (i) to pursue the same remedies against the Contractor as it could pursue in the event of a breach of the contract by the Contractor, and (ii) as a penalty in addition to any other damages to which it may be entitled by law, to exemplary damages in an amount (as determined by the Secretary or his duly authorized representative) which shall be not less than three nor more than ten times the costs incurred by the Contractor in providing any such gratuities to any such officer or employee.

c. The rights and remedies of the Government provided in this clause shall not be exclusive and are in addition to any other rights and remedies provided by law or under this contract.

Article 15. Approval. This contract shall be subject to the written approval of the Division Engineer, North Central Division, Corps of Engineers, Chicago, Illinois, or his authorized representative, and shall not be binding until so approved.

Article 16. Definitions.

a. The term "head of the agency" or "Secretary" as used herein means the Secretary of the Army; and the term "his duly authorized representative" means the Chief of Engineers, Department of the Army, or an individual or board designated by him.

b. The term "Contracting Officer" as used herein means the person executing this contract on behalf of the Government and includes a duly appointed successor or authorized representative.

IN WITNESS WHEREOF, the parties hereto have executed this contract as of the day and year first above written.

THE UNITED STATES OF AMERICA

By_____
Colonel, Corps of Engineers
Contracting Officer

THE BALTIMORE AND OHIO RAILROAD COMPANY
(Owner)

By_____

Title_____

NORFOLK AND WESTERN RAILWAY COMPANY
(Cooperating Railway)

By_____

Title_____

I, _____, certify that I am the _____ Secretary of the corporation named as Owner herein, that _____ who signed this contract on behalf of the Owner was then _____ of said corporation; that said contract was duly signed for and on behalf of said corporation by authority of its governing body and is within the scope of its corporate powers.

IN WITNESS WHEREOF, I have hereunto affixed my hand and the seal of said corporation this _____ day of _____ 1979.

(CORPORATE SEAL)

_____
(Secretary)

I, _____, certify that I am the _____ Secretary of the corporation named as Cooperating Railway herein; that _____ was then _____ of said corporation, that said contract was duly signed for and on behalf of said corporation by authority of its governing body and is within the scope of its corporate powers.

IN WITNESS WHEREOF, I have hereunto affixed my hand and the seal of said corporation this _____ day of _____ 1979.

(CORPORATE SEAL)

_____
(Secretary)

DEPARTMENT OF THE ARMY
BUFFALO DISTRICT, CORPS OF ENGINEERS
1776 NIAGARA STREET
BUFFALO, NEW YORK 14207

PUBLIC NOTICE

FLOOD PROTECTION AT BIG CREEK, CLEVELAND, OHIO

1. This public notice has been prepared and distributed to identify what dredged or fill materials will be discharged into waters of the United States by implementation of the proposed project, and to provide an opportunity for any person affected by such discharge of materials, to request a public hearing.

2. The Corps of Engineers was authorized to study the feasibility of flood protection in Big Creek Watershed, OH, by Public Law 91-611, passed 31 December 1970, and entitled River and Harbor Act of 1970. A Phase I General Design Memorandum and Draft Environmental Statement, for the proposed project, have been prepared and distributed.

3. The proposed plan, called the Cleveland Zoo-Protector Products Floodway/Diversion plan, includes 4,250 feet of floodway, a diversion 1,110 feet long, modification of 1,860 feet of existing channel, and 4,400 feet of relocated railroad line (see attached plate).

4. The proposed plan does not include any discharge of dredged material into U.S. waters. The plan does include placement of rock riprap on 69,200 square feet (1.59 acres) of Big Creek bottom and banks. Riprap will be used as a 100-foot long transition from the outlet of the existing 2-barrel culvert to the open channel in Cleveland Zoo. This riprap will be placed on approximately 8,000 square feet (.18 acre) of creek bottom and banks. Another 1,530-foot section of existing creek channel will be riprapped beginning 100-feet downstream of the 3-barrel conduit outlet, just east of the zoo. This riprap will cover about 61,200 feet (1.41 acres) of creek banks. The riprapped areas may provide better habitat quality than presently exists but will inhibit any natural diversity or succession from occurring.

5. The Corps study documents, including the Phase I General Design Memorandum Report and Draft Environmental Statement, both dated May 1977, are being reviewed in accordance with the following laws:

Federal Water Pollution Control Act, 1972
National Environmental Policy Act of 1969
Fish and Wildlife Act of 1956
Fish and Wildlife Coordination Act, 1958
Endangered Species Act of 1973
National Historic Preservation Act of 1966

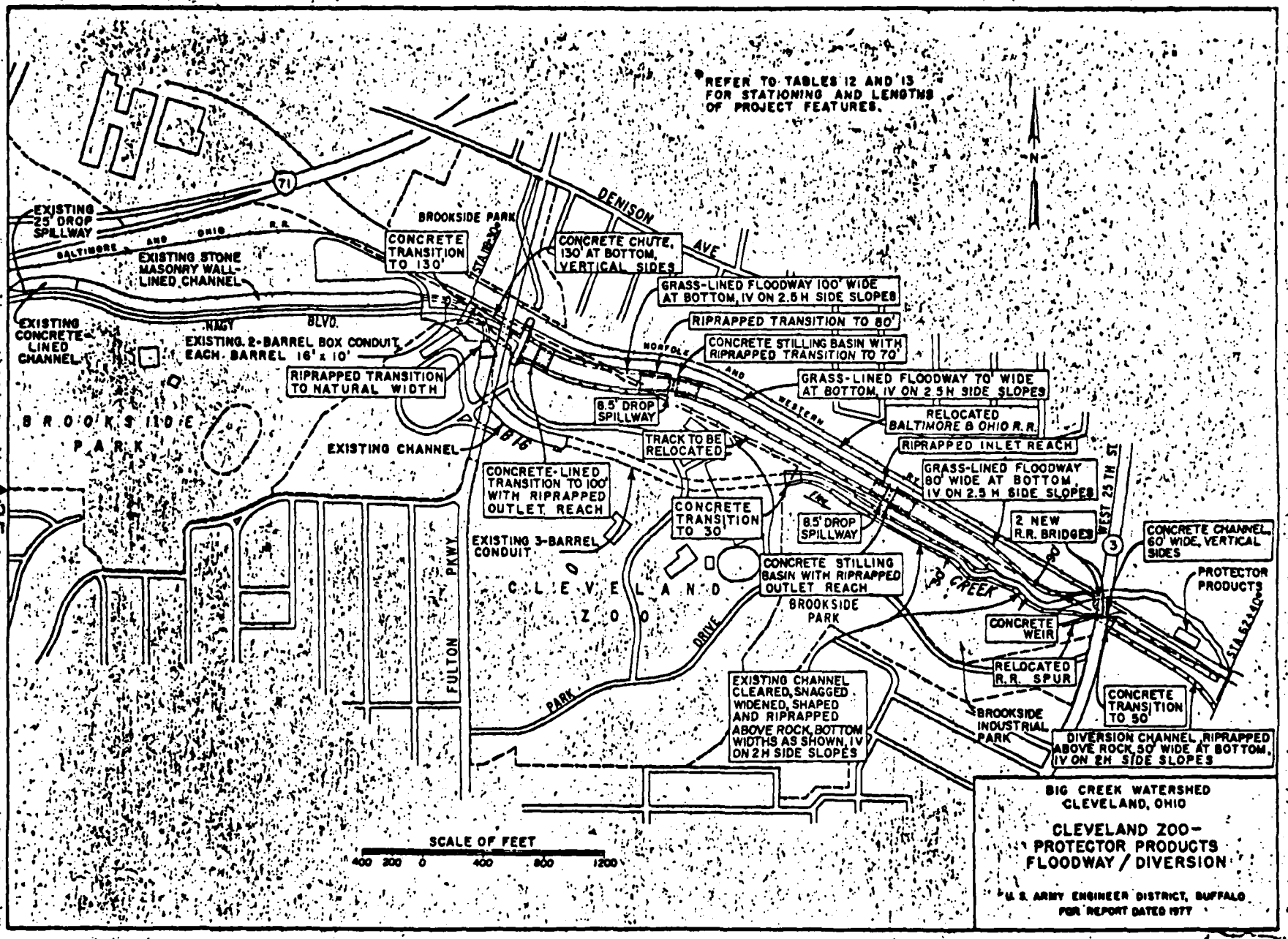
6. The Corps is coordinating with the following interested agencies:

Various City of Cleveland Departments
Cuyahoga County Regional Planning Commission
Northeast Ohio Areawide Coordinating Agency
Ohio Department of Health
Ohio Department of Natural Resources
Ohio Environmental Protection Agency
U.S. Department of Health, Education & Welfare
U.S. Department of the Interior
U.S. Environmental Protection Agency

7. This notice is being published in conformance with 40 U.S. Code of Federal Regulations 230 and Section 404 of Public Law 92-500. Any person who has an interest which may be affected by the rock riprap fill may request a public hearing. The request must be submitted, in writing, to the District Engineer within 30 days of the date of this notice and must clearly set forth the interest which may be affected and the manner in which the interest may be affected by this activity.

Daniel D. Ludwig
DANIEL D. LUDWIG
Colonel, Corps of Engineers
District Engineer

NOTICE TO POSTMASTER: It is requested that the above notice be conspicuously displayed for 30 days from the date of issuance.


REFER TO TABLES 12 AND 13 FOR STATIONING AND LENGTHS OF PROJECT FEATURES.
N
71
EXISTING 25' DROP SPILLWAY
BALTIMORE AND OHIO R.R.
EXISTING STONE MASONRY WALL-LINED CHANNEL
BROOKSIDE PARK
CONCRETE TRANSITION TO 130'
STA 8+00
CONCRETE CHUTE, 130' AT BOTTOM, VERTICAL SIDES
DENISON AVE
GRASS-LINED FLOODWAY 100' WIDE AT BOTTOM, IV ON 2.5 H SIDE SLOPES
RIPRAPPED TRANSITION TO 80'
CONCRETE STILLING BASIN WITH RIPRAPPED TRANSITION TO 70'
NORFOLK AND WESTERN
GRASS-LINED FLOODWAY TO WIDE AT BOTTOM, IV ON 2.5 H SIDE SLOPES
RELOCATED BALTIMORE & OHIO R.R.
RIPRAPPED INLET REACH
GRASS-LINED FLOODWAY 80' WIDE AT BOTTOM IV ON 2.5 H SIDE SLOPES
EXISTING CONCRETE-LINED CHANNEL
NASA BLVD.
EXISTING 2-BARREL BOX CONDUIT EACH BARREL 16' x 10'
RIPRAPPED TRANSITION TO NATURAL WIDTH
8.5' DROP SPILLWAY
TRACK TO BE RELOCATED
EXISTING CHANNEL
CONCRETE-LINED TRANSITION TO 100' WITH RIPRAPPED OUTLET REACH
CONCRETE TRANSITION TO 30'
8.5' DROP SPILLWAY
2 NEW R.R. BRIDGES
WEST 25TH ST
CONCRETE CHANNEL, 60' WIDE, VERTICAL SIDES
EXISTING 3-BARREL CONDUIT
CONCRETE STILLING BASIN WITH RIPRAPPED OUTLET REACH
BROOKSIDE PARK
BIG CREEK
PROTECTOR PRODUCTS
CONCRETE WEIR
STA 62+40
RELOCATED R.R. SPUR
EXISTING CHANNEL CLEARED, SNAGGED, WIDENED, SHAPED AND RIPRAPPED ABOVE ROCK, BOTTOM WIDTHS AS SHOWN, IV ON 2H SIDE SLOPES
CONCRETE TRANSITION TO 50
BROOKSIDE INDUSTRIAL PARK
DIVERSION CHANNEL, RIPRAPPED ABOVE ROCK, 50' WIDE AT BOTTOM, IV ON 2H SIDE SLOPES
FULTON PKWY
PARK DRIVE
A25
SCALE OF FEET
400 200 0 400 800 1200
BIG CREEK WATERSHED
CLEVELAND, OHIO
CLEVELAND ZOO-
PROTECTOR PRODUCTS
FLOODWAY / DIVERSION
U.S. ARMY ENGINEER DISTRICT, BUFFALO
FOR REPORT DATED 1977

FLOOD PROTECTION AT BIG CREEK, CLEVELAND, OHIO

SECTION 404 EVALUATION

1. Introduction. The Corps of Engineers was authorized to study the feasibility of flood protection in Big Creek Watershed, OH, by Public Law 91-611, passed 31 December 1970, and entitled River and Harbor Act of 1970. The proposed plan, called the Cleveland Zoo-Protector Products Floodway/Diversion plan, includes 4,250 feet of floodway, a diversion 1,110 feet long, modification of 1,860 feet of existing channel, and 4,400 feet of relocated railroad line.

1.1 The proposed plan does not include any discharge of dredged material into U.S. waters. The plan does include placement of rock riprap on 69,200 square feet (1.59 acres) of Big Creek bottom and banks. Since fill material will be deposited in waters of the United States, the Big Creek flood protection project must comply with provisions of Section 404 of the Federal Water Pollution Control Act Amendments of 1972.

2. Public Participation. Two public meetings were held in Cleveland on 24 August 1971 and on 28 July 1977. A public workshop was conducted in Cleveland on 18 February 1976 and a formulation workshop was held on 11 January 1977.

2.1 A Draft Environmental Statement was circulated for public review on 27 May 1977. A Section 404 public notice was circulated on 8 June 1977 and the 30-day public review period expired without any response.

3. Evaluation. Effect on Water Quality-Physical Effects: There will be a short-term low-magnitude increase in turbidity of creek water during placement of rock riprap.

3.1 Effect on Water Quality-Chemical Effects: The proposed rock riprap fill will not affect chemical water quality.

3.2 Effect on Benthos: The riprapped areas will replace existing benthic habitat and biota. Riprap will provide better benthic habitat quality than currently exists but will inhibit any natural diversity or succession of benthos from occurring.

3.3 Effect on Fishery Resources: Placement of rock riprap after stream channelization should result in little impact to the existing fishery. A fish survey conducted during the spring, summer, and fall of 1976 revealed that the stream, in the project area, is grossly polluted and contains fish, few in species and number,

3.4 Effects on Recreation and Municipal Water Supply: The proposed rock riprap fill will not affect recreation or water supplies.

4. Alternatives. The "no action" alternative would not meet the flood protection needs of the industrial, commercial and recreational community.

4.1 The Non-structural Base Plan would prevent flood damage at individual sites of high damage. Big Creek would continue to flood uncontrolled; however, some flood damageable property would be protected either because of its relocation from the flood plain, or because of protection provided by floodproofing measures installed in all openings accessible to 100-year flooding. Operational dependability of this plan would be indeterminate. It would depend largely on the stability of each floodproofed building during flooding. Foundations of walls of these buildings could be damaged or caused to collapse under dynamic loading of fast-flowing floodwater or debris carried by it. Such damage would reduce supposed benefit of this plan.

4.2 The Brookside Park Reservoir Plan would consist of a detention reservoir on Big Creek in Brookside Park. The reservoir would detain excess floodwater and release it at non-damaging rates to protect downstream interests. Normally, the reservoir would be dry but it would provide storage for 100-year protection. The dam and intermittent reservoir would result in a major adverse aesthetic impact and the plan would severe John Nagy Boulevard. In addition, a 40-acre woodland would be converted into an intensely used park facility causing major adverse impacts to the human and natural environment.

4.3 The Brookside Park-Industrial Park Diversion Plan (50-year) would consist of a diversion to replace the existing channel from the downstream side of Brookside Park to the downstream side of Brookside Industrial Park. This plan would provide 50-year protection for Brookside Park, the Cleveland Zoo, and Brookside Industrial Park, but would not provide any flood protection for Protector Products and adjacent industrial interests.

4.4 The Brookside Park-Industrial Park Diversion Plan (100-year) would consist of a diversion, providing 100-year flood protection, to replace the same reach of existing channel as in the 50-year plan.

4.5 The Brookside Park-Protector Products Diversion Plan would include construction of a two-reach diversion to supplement the existing channel from the downstream side of Brookside Park to the downstream side of Protector Products. This alternative would provide 100-year flood protection from the concrete-lined channel in Brookside Park to roughly 300 feet downstream from Protector Products. While this plan would protect Brookside Park it would be more costly than the selected plan.

5. Current Project Status. The project is currently in the Phase I GDM stage. If later stages of project planning are authorized and completed in a timely manner, construction could begin in the Spring of 1979.

6. Conclusion and Determination. I have reviewed the documents pertinent to the Big Creek Flood Protection project. Having concluded:

a. that all concerns over adverse impacts on water quality and aquatic ecosystems have been resolved, and

b. that sufficient opportunity for public input was provided during planning stages.

I have determined that the Big Creek Flood Protection project complies with the provisions of Section 404 of the Federal Water Pollution Control Act Amendments of 1972. No additional public notices or evaluations are required.

Daniel D. Ludwig

DANIEL D. LUDWIG
Colonel, Corps of Engineers
District Engineer

DATE: 22 Sept 77

SUPPLEMENTAL INFORMATION REPORT
TO THE NOVEMBER 1977 FINAL ENVIRONMENTAL STATEMENT
BIG CREEK FLOOD PROTECTION PROJECT
CLEVELAND, OHIO

U. S. Army Engineer District, Buffalo
Buffalo, New York
August 1979

A 29

1. INTRODUCTION

1.01 The Final Environmental Impact Statement (FEIS) for the Phase I General Design Memorandum (GDM) of the Big Creek Flood Protection Project was dated November 1977 and was filed at USEPA on 8 February 1978. In accordance with paragraph 12b of ER 200-2-2, this Supplemental Information Report describes and evaluates Phase II GDM minor design changes and supplements information on other design features generally addressed in the FEIS.

2. DESCRIPTION AND EVALUATION OF MINOR DESIGN CHANGES

2.01 Plate 1 illustrates the design which was presented as the selected plan in the November 1977 FEIS. Plate 2 illustrates the Phase II GDM design, including the changes as described and evaluated below:

a. Realignment of Chessie (B&O) Railroad Spur Track and Bridge Relocation (see Area "A" on Plates 1 and 2). The alignment of the relocated B&O railroad spur line has been revised. The Phase I GDM relocation was not acceptable for engineering reasons since the bridge over the diversion channel was too long and complex and it adversely affected diversion channel hydraulics. The new upstream spur track alignment will include the construction of a 170-foot bridge to span the creek, instead of the diversion channel. Aside from the visual changes, not necessarily beneficial or adverse, the realignment will not significantly change the environmental impacts of the original track and bridge relocation alignment.

b. Replacement of Two 8.5-Foot Floodway Drop Structures with Five 3-3.5 Riprap-Lined Channel Drops (see Area "B" on Plates 1 and 2). The two 8.5-foot floodway drop structures have been replaced with five 3-3.5-foot riprap-lined drops. This change has been made to align the floodway bottom closer and more parallel to the bedrock profile in the project area, thus decreasing the total rock excavation required. The 3.5-foot riprapped drops will also be safer than the 8.5-foot drop structures for people, particularly children, who might wander into the normally dry floodway. The floodway and modified channel will be grassed-lined except in the locations of the drop structure as shown on Plate 2. The diversion channels' side slopes and bottom will be protected throughout by riprap or concrete as detailed in the Phase I GDM, and shown herein on Plate 2.

c. Elimination of the Levee Structure Between the Floodway and Natural Creek (see Area "C" on Plates 1 and 2). The Phase I GDM design included a levee between 1,470 linear feet of parallel creek and floodway channels. This design feature has been revised to eliminate the levee, thereby combining the floodway and original channel

in the cross section configuration, including low-flow channel, as illustrated in Figure 1. The levee was found unfeasible when design refinements revealed that areal restrictions decreased the area available to the levee, reducing it to a floodwall. The purpose of the levee was to maximize the length of the 30-foot wide natural creek channel before its confluence with the floodway. However, reducing the levee to a floodwall would partially defeat the purpose of the levee since it would be aesthetically unnatural and unappealing as well as very expensive. The 30-foot wide low-flow channel within the combined channel-floodway is a feasible alternative which will minimize impacts to the natural environment, and while unnatural, will be more appealing than the feasible floodwall alternative.

d. Modification, Realignment and Extension of the Diversion Flume (see Area "D" on Plates 1 and 2). The diversion channel flume has been lengthened approximately 100 feet, decreased in width from 60 to 50 feet and realigned so it passes through the West 25th Street bridge parallel to the bridge piers. The flume was extended to insure that the realigned railroad embankment will not be affected by high velocity flows. The width was decreased and the alignment straightened since the West 25th Street bridge pier foundation was found to extend beyond the limits previously used during the Phase I GDM. These design changes will not appreciably alter the impacts associated with the original design.

e. Realignment of the Diversion Channel Outlet (see Area "E" on Plates 1 and 2). The outlet of the diversion channel has been modified to adjust for changed conditions in the project area. A landfill operation in the project area has altered the course of the creek in the vicinity of the planned diversion outlet. The diversion outlet alignment change was, therefore, necessary to insure that the outlet will join with the relocated creek. This realignment will have negligible effects on the impacts of the original design.

3. SUPPLEMENTAL INFORMATION ON DESIGN FEATURES DESCRIBED IN THE FINAL ENVIRONMENTAL IMPACT STATEMENT.

3.01 Construction of the floodway diversion channel and channelized creek sections will require excavation and disposal of approximately 150,000 cubic yards of soil and rock. As stated in Section 4.02 of the FEIS, "All material to be disposed of will be hauled to nearby landfill dumps." The disposal area has now been identified as shown on Plate 3. The area, known as Gardner Flats, is owned by Cleveland Metroparks and was suggested by that agency as the disposal site. Cleveland Metroparks has utilized the site for trash and debris disposal for many years.

3.02 The excavated material will be transported from the project area to the disposal area by truck, a distance of approximately 13 miles. Any wet excavated material, from the channelized sections of the creek, will be dewatered at the creek before being transported. This practice will minimize leakage along roadways.

3.03 The use of Gardner Flats as a disposal site for the Big Creek Flood Control Project is in compliance with EO 11988; and Section 404(r) is not applicable to the Gardner Flats site. The exact location of the disposal area is not known with regard to the East Rocky River flood plain as insufficient data are available. However, based on flood plain information reports upstream and downstream of the disposal site, the Gardner Flats site has been determined to be located in the flood plain outside the effective flow area. Consequently, filling this area is not expected to significantly affect the stage frequency curve in the vicinity. Further, Metroparks owns and maintains the area upstream and downstrem of the disposal site and the filling of Gardner Flats will have little impact on flood or human safety. Gardner Flats is presently used as a dump site by Metroparks, and, as such, various kinds of debris (concrete, rubble, organic debris, etc.) can be observed in the area. The Corps use of the site is anticipated to environmentally enhance the area as Metroparks Wildlife manager has stated that after the disposal is complete, Metroparks will develop a much needed feeding station on the site for migratory birds passing the Cleveland area.

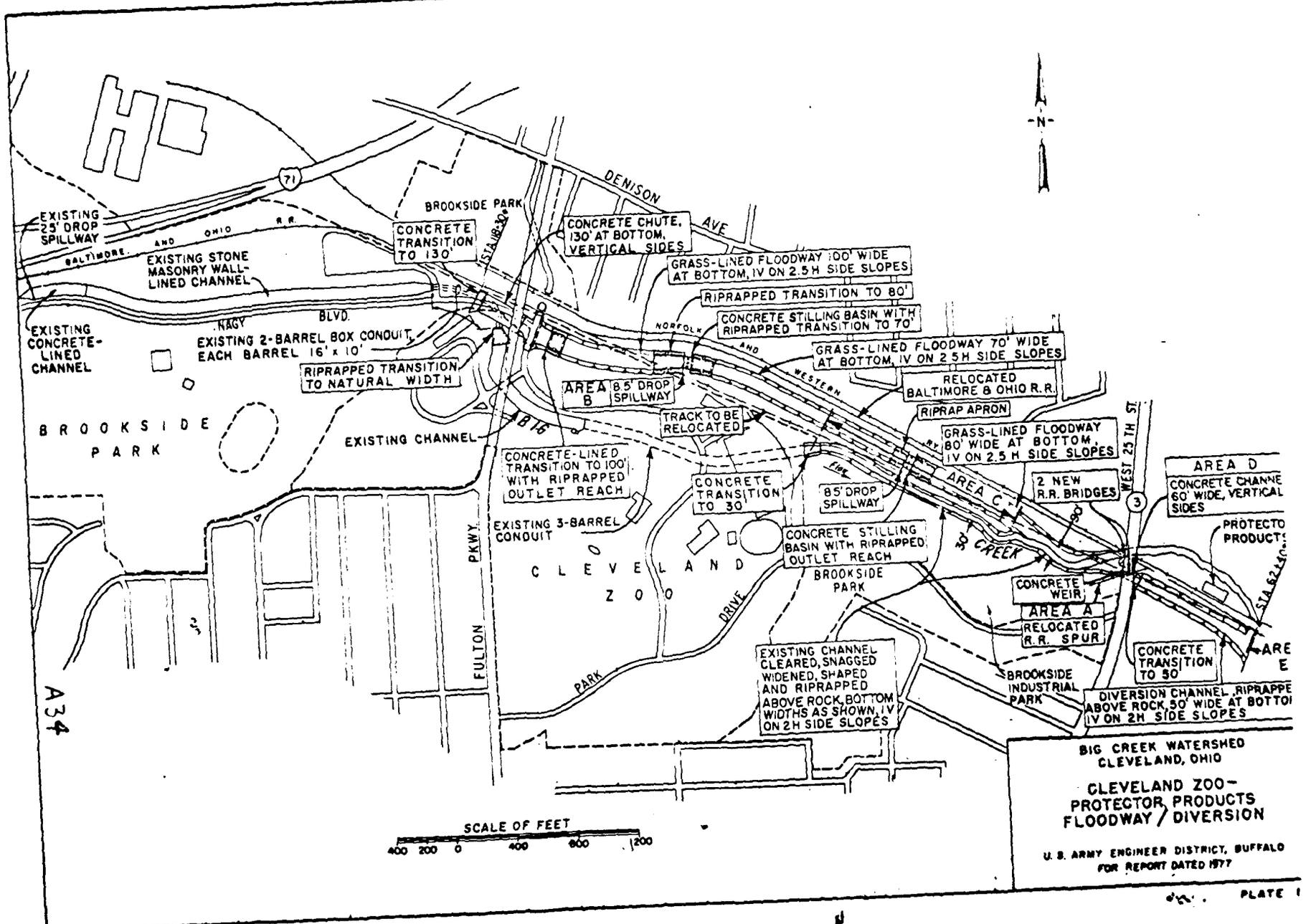
3.04 The landfill, mentioned in Section 2.01e of this statement, now partially encroaches on the diversion channel alignment. Therefore, in addition to the diversion channel material to be excavated, an unspecified volume of landfill material will be excavated and disposed at the Gardner Flats area. The operator of the landfill, Leone Trucking Company, was contacted through the city of Cleveland by letter of 16 October 1978, requesting detailed information on the constituents of the landfill. The company replied through the city of Cleveland, by letter of 23 October 1978, that the landfill consisted of concrete, brick, rock, earth, wood, rubbish, sand, and cinders. Impacts of excavation and disposal of the landfill material are expected to be minimal but are largely unspecified, because of lack of detailed information concerning the materials make-up.

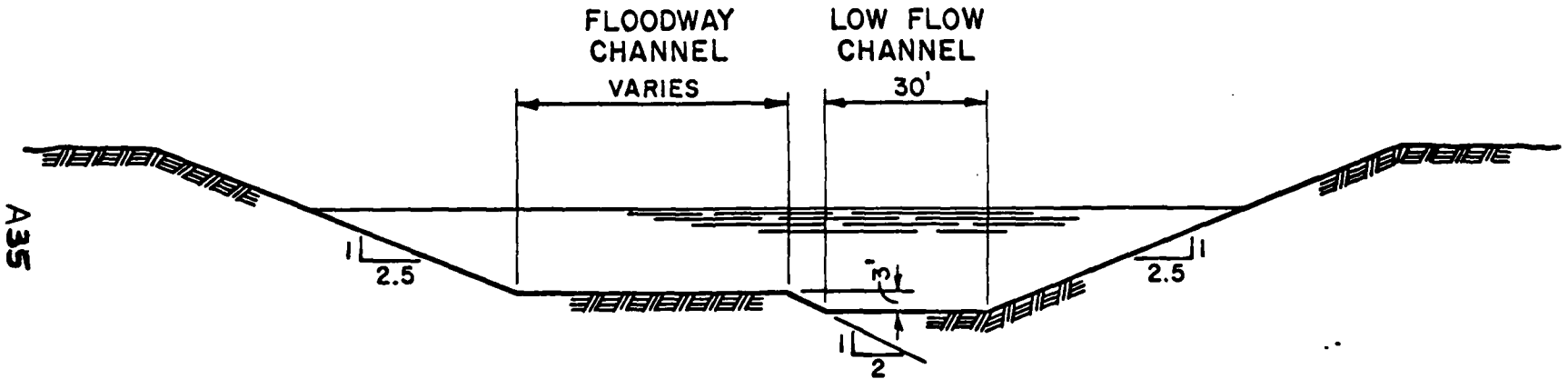
4. COORDINATION.

4.01 The minor project changes and supplemental information were discussed at a meeting conducted in Cleveland, OH, by the Buffalo District on 15 November 1978. The meeting, which included a field trip to the project and disposal areas, was attended by representatives of the U. S. Fish and Wildlife Service, Ohio Department of

Natural Resources, Ohio Environmental Protection Agency, Cleveland Metroparks, and Lake Erie Watershed Conservation Foundation. The Cuyahoga County Regional Planning Commission, Northeast Ohio Areawide Coordinating Agency, and U. S. Environmental Protection Agency were invited to the meeting but did not attend.

4.02 At the conclusion of the meeting, all participants specifically approved of the project changes and clarifications described in this statement.

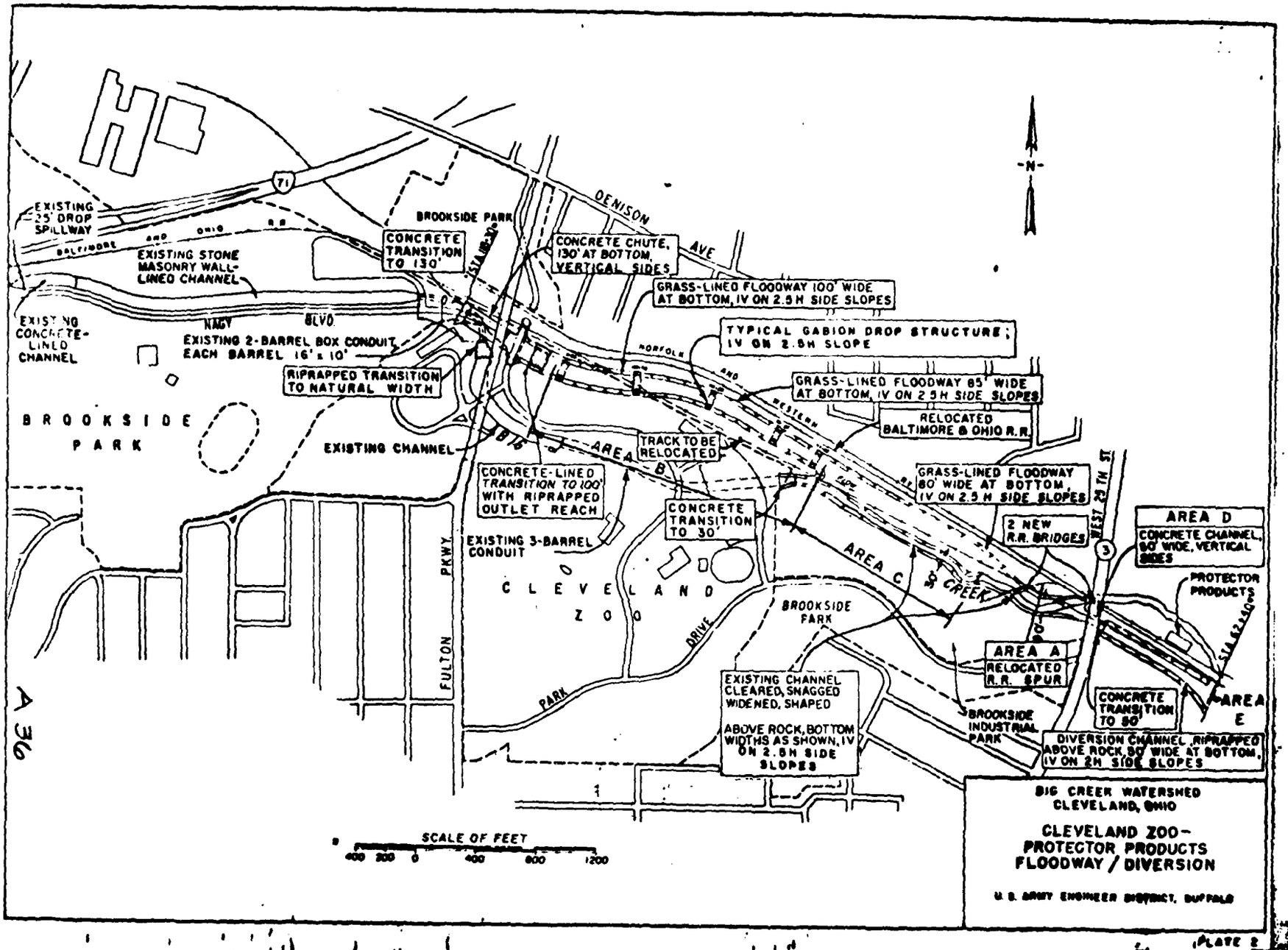

-N-
DENISON AVE
BROOKSIDE PARK
CONCRETE TRANSITION TO 130'
STA 18+30
CONCRETE CHUTE, 130' AT BOTTOM, VERTICAL SIDES
GRASS-LINED FLOODWAY 100' WIDE AT BOTTOM, IV ON 2.5H SIDE SLOPES
RIPRAPPED TRANSITION TO 80'
CONCRETE STILLING BASIN WITH RIPRAPPED TRANSITION TO 70'
GRASS-LINED FLOODWAY 70' WIDE AT BOTTOM, IV ON 2.5H SIDE SLOPES
RELOCATED BALTIMORE & OHIO R.R.
RIPRAP APRON
GRASS-LINED FLOODWAY 80' WIDE AT BOTTOM, IV ON 2.5 H SIDE SLOPES
2 NEW R.R. BRIDGES
AREA D
CONCRETE CHANNE 60' WIDE, VERTICAL SIDES
PROTECTO PRODUCT
STA 62+40
ARE E
AREA C
AREA B 8.5' DROP SPILLWAY
TRACK TO BE RELOCATED
EXISTING 25' DROP SPILLWAY
BALTIMORE AND OHIO R.R.
EXISTING STONE MASONRY WALL-LINED CHANNEL
NAGY BLVD.
EXISTING CONCRETE-LINED CHANNEL
EXISTING 2-BARREL BOX CONDUIT, EACH BARREL 16' x 10'
RIPRAPPED TRANSITION TO NATURAL WIDTH
BROOKSIDE PARK
EXISTING CHANNEL
CONCRETE-LINED TRANSITION TO 100' WITH RIPRAPPED OUTLET REACH
CONCRETE TRANSITION TO 30
8.5' DROP SPILLWAY
EXISTING 3-BARREL CONDUIT
CONCRETE STILLING BASIN WITH RIPRAPPED OUTLET REACH
CLEVELAND ZOO
FULTON PKWY.
PARK DRIVE
BROOKSIDE PARK
BIG CREEK
CONCRETE WEIR
AREA A
RELOCATED R.R. SPUR
BROOKSIDE INDUSTRIAL PARK
EXISTING CHANNEL CLEARED, SNAGGED WIDENED, SHAPED AND RIPRAPPED ABOVE ROCK BOTTOM WIDTHS AS SHOWN, IV ON 2H SIDE SLOPES
CONCRETE TRANSITION TO 50'
DIVERSION CHANNEL, RIPRAPPE ABOVE ROCK 50' WIDE AT BOTTOI IV ON 2H SIDE SLOPES
WEST 25TH ST
A34
SCALE OF FEET
400 200 0 400 800 1200
BIG CREEK WATERSHED
CLEVELAND, OHIO
CLEVELAND ZOO-
PROTECTOR PRODUCTS
FLOODWAY / DIVERSION
U. S. ARMY ENGINEER DISTRICT, BUFFALO
FOR REPORT DATED 1977
PLATE



A35

BIG CREEK WATERSHED
CLEVELAND, OHIO
FLOODWAY
LOW FLOW CHANNEL
CROSS SECTION
U.S. ARMY ENGINEER DISTRICT BUFFALO

FIGURE 1


EXISTING 25' DROP SPILLWAY
BALTIMORE AND OHIO R.R.
EXISTING STONE MASONRY WALL-LINED CHANNEL
EXISTING CONCRETE-LINED CHANNEL
NAGY BLVD.
EXISTING 2-BARREL BOX CONDUIT, EACH BARREL 16' x 10'
RIPRAPPED TRANSITION TO NATURAL WIDTH
BROOKSIDE PARK
EXISTING CHANNEL
CONCRETE TRANSITION TO 130'
BROOKSIDE PARK
DENISON AVE
CONCRETE CHUTE, 130' AT BOTTOM, VERTICAL SIDES
GRASS-LINED FLOODWAY 100' WIDE AT BOTTOM, 1V ON 2.5H SIDE SLOPES
TYPICAL GABION DROP STRUCTURE; 1V ON 2.5H SLOPE
NORFOLK AND WESTERN
GRASS-LINED FLOODWAY 85' WIDE AT BOTTOM, 1V ON 2.5H SIDE SLOPES
RELOCATED BALTIMORE & OHIO R.R.
TRACK TO BE RELOCATED
AREA B
CONCRETE-LINED TRANSITION TO 100' WITH RIPRAPPED OUTLET REACH
CONCRETE TRANSITION TO 30'
GRASS-LINED FLOODWAY 80' WIDE AT BOTTOM, 1V ON 2.5H SIDE SLOPES
2 NEW R.R. BRIDGES
WEST 29TH ST
AREA D
CONCRETE CHANNEL, 80' WIDE, VERTICAL SIDES
PROTECTOR PRODUCTS
EXISTING 3-BARREL CONDUIT
CLEVELAND ZOO
FULTON PKWY.
AREA C
BIG CREEK
BROOKSIDE PARK DRIVE
BROOKSIDE PARK
AREA A
RELOCATED R.R. SPUR
CONCRETE TRANSITION TO 30'
AREA E
EXISTING CHANNEL CLEARED, SNAGGED WIDENED, SHAPED
ABOVE ROCK, BOTTOM WIDTHS AS SHOWN, 1V ON 2.5H SIDE SLOPES
BROOKSIDE INDUSTRIAL PARK
DIVERSION CHANNEL, RIPRAPPED ABOVE ROCK, 80' WIDE AT BOTTOM, 1V ON 2H SIDE SLOPES
N
SCALE OF FEET
400 200 0 400 800 1200
BIG CREEK WATERSHED
CLEVELAND, OHIO
CLEVELAND ZOO-
PROTECTOR PRODUCTS
FLOODWAY / DIVERSION
U.S. ARMY ENGINEER DISTRICT, BUFFALO
PLATE 2

A 36

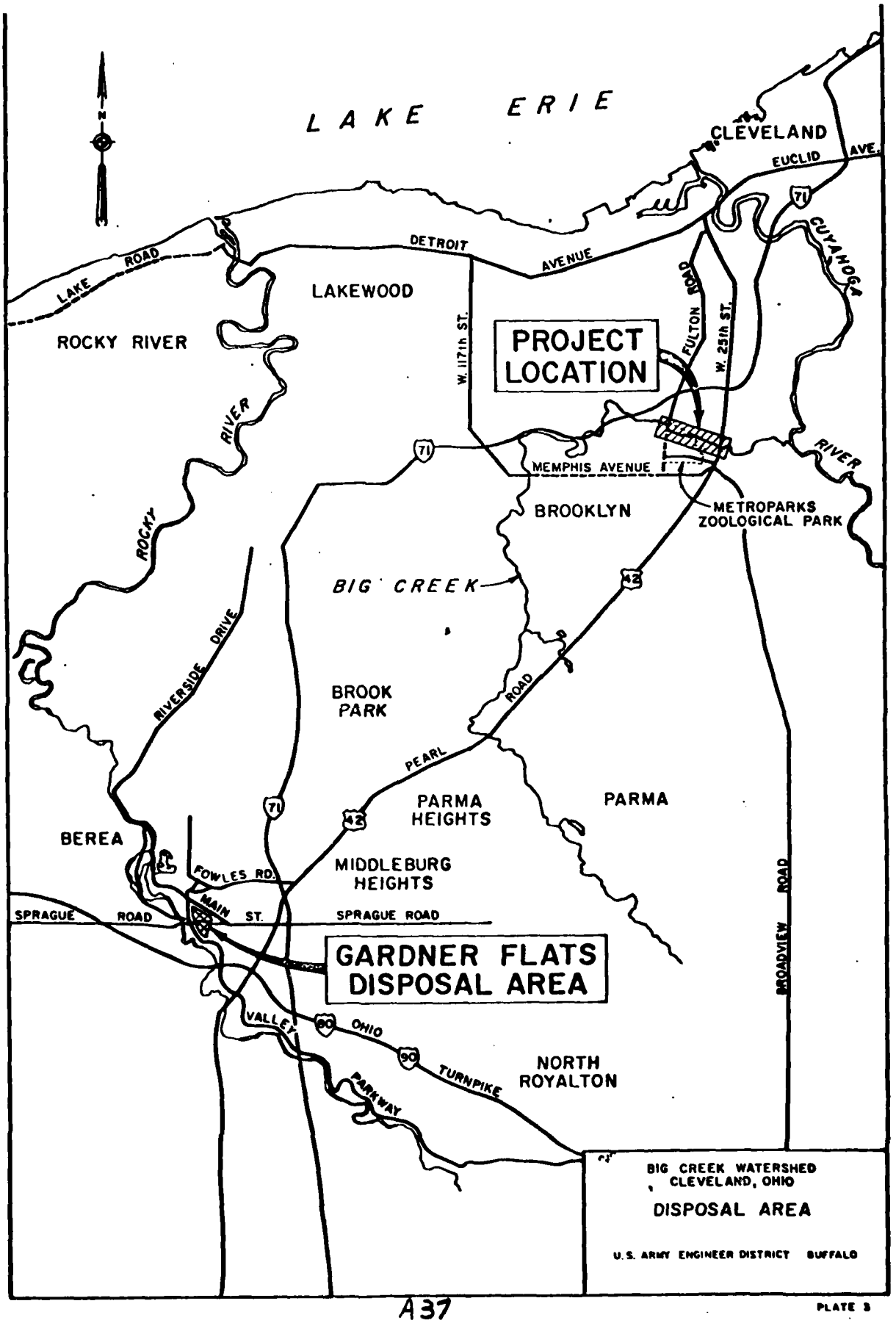

LAKE ERIE
CLEVELAND
EUCLID AVE.
71
CUYAHOGA
DETROIT AVENUE
LAKE ROAD
LAKEWOOD
ROCKY RIVER
W. 117th ST.
PROJECT LOCATION
FULTON ROAD
W. 25th ST.
RIVER
ROCKY RIVER
71
MEMPHIS AVENUE
BROOKLYN
METROPARKS ZOOLOGICAL PARK
BIG CREEK
42
RIVERSIDE DRIVE
BROOK PARK
ROAD
PEARL
PARMA HEIGHTS
PARMA
BEREA
71
42
FOWLES RD.
MIDDLEBURG HEIGHTS
MAIN ST.
SPRAGUE ROAD
SPRAGUE ROAD
GARDNER FLATS DISPOSAL AREA
BROADVIEW ROAD
VALLEY
80
OHIO
90
TURNPIKE
NORTH ROYALTON
PARKWAY
BIG CREEK WATERSHED
CLEVELAND, OHIO
DISPOSAL AREA
U.S. ARMY ENGINEER DISTRICT BUFFALO

PLATE 3

OhioEPA

Re: Cuyahoga County
Cleveland
Grant of 401 Certification
Project For Flood Protection Project in
Big Creek
Public Notice No. (B) NCBED-PE

January 17, 1979

Buffalo Corps of Engineers
1776 Niagara Street
Buffalo, New York 14207

Gentlemen:

Pursuant to Section 401 of the Federal Water Pollution Control Act, Public Law 92-500, the Ohio Environmental Protection Agency hereby certifies that the above-referenced project will comply with the applicable provisions of Sections 301, 302, 304, 306, and 307 and Section 402 of the Federal Water Pollution Control Act. This certification is specifically limited to a 401 certification with respect to water pollution and does not relieve the applicant of further certifications or permits as may be necessary under the law. This Certification is issued subject to the following conditions:

Positioning of facility as indicated will in no way impede the natural flow of water to an extent sufficient to cause stagnation thus rendering such waters unfit for municipal, industrial, agricultural, or other uses.

Positioning of facility as indicated will in no way impede the natural flow of water to an extent sufficient to cause stagnation where such waters receive municipal, industrial, agricultural, or other discharges.

Extreme care must be employed during construction of the facility to avoid creation of unnecessary turbidity.

Steps shall be taken during construction to minimize bank erosion.

Steps are to be taken, upon completion of the facility or maintenance construction, to insure bank stability. This may include, but is not limited to, placement of riprap or bank seeding.

The riprap employed is to be of such weight and size that bank stress or slump conditions will not be created due to its placement.

Fill used in this project will not be of a polluted nature.

The defoliation system to be used on this project will not include the use of herbicides that do not meet the approval of the Ohio E.P.A.

Any damages caused to the immediate environment of the project by equipment needed for construction or hauling will be repaired immediately.

Care will be taken to avoid various types of pollution while work is performed in waters of the State. Careful housekeeping, good vehicles maintenance, sound engineering design, and constant supervision of the contractor by the owner will avoid pollution from poor construction techniques, oil and gas spills, and construction debris in the river.

You are hereby notified that this action of the Director is final and may be appealed to the Environmental Board of Review pursuant to Section 3745.04 of the Ohio Revised Code by any person who was a party to this proceeding. The appeal must be in writing and set forth the action complained of and the grounds upon which the appeal is based. It must be filed with the Environmental Board of Review within thirty (30) days after the notice of the Director's action. A copy of the appeal must be served on the Director of the Ohio Environmental Protection Agency and the Environmental Law Division of the Office of the Attorney General within three (3) days of the filing with the Board. An appeal may be filed with the Environmental Board of Review at the following address:

Environmental Board of Review
Suite 305
395 E. Broad Street
Columbus, Ohio 43215

Very truly yours,

James F. McAvoy

James F. McAvoy
Director

JFM/rb

Copy to Division of Water, DNR
Copy to Office of Planning Coordinator, OEPA

jhr/2175

NCBED-PE 1 March 1979

Conrad Fjetland, Supervisor
U.S. Fish and Wildlife Service
3990 East Broad Street
Columbus, OH 43215

Dear Mr. Fjetland:

This letter is in response to your 28 February 1979 telephone conversation with Paul Lang and George Brooks concerning the Big Creek Flood Protection Project.

Page 114 of the Final Environmental Statement (copy enclosed) contains the USDI commenting letter. The second comment of that letter states, "The final statement should discuss measures proposed to mitigate the adverse impacts from channelization". The Corps response, on page 115 of the FES, states, "Small riffles and pools will be designed for channelized sections of the project during the Phase II GDM stage of the project."

The Corps now feels, after substantially completing the detailed design, that constructed riffles and pools would not result in significant ecological benefits because of the normally low flows and bedrock substrate. We, therefore, propose to construct our channel generally using the natural bedrock bottom. The uneven bottom will provide small depressions where sediment and detritus can collect, thus providing maximum benthic habitat diversity. Some excavated rock will also be left in the channel thereby further increasing habitat variability. These measures will hopefully optimize the diversity of the post construction biotic community. Your comments addressing these suggested design changes would be appreciated.

Sincerely yours,

1 Incl
As stated

DANIEL D. LUDWIG
Colonel, Corps of Engineers
District Engineer

Lang
Gilbert
Brooks
Foley
Hallock/
Liddell
Braun
Ludwig

CF:
NCBED-PE ✓

A40

United States Department of the Interior

FISH AND WILDLIFE SERVICE

IN REPLY REFER TO:

Division of Ecological Services
Columbus Field Office
3990 East Broad Street
Columbus, Ohio 43215

April 4, 1979

Colonel Daniel D. Ludwig
District Engineer
U. S. Army Engineer District
Buffalo
1776 Niagara Street
Buffalo, New York 14207

Dear Colonel Ludwig:

This letter is in response to your letter dated March 1, 1979 concerning the Big Creek Flood Protection Project.

Since the Corps believes "that constructed riffles and pools would not result in significant ecological benefits because of the normally low flows and bedrock substrate", we recommend that single boulder deflectors be used. The placement of these deflectors should be determined in conjunction with available shade and cover.

Please refer to your letter, third paragraph, where you state "excavated rock will also be left in the channel, thereby further increasing habitat variability". This excavated rock should be placed downstream from boulders of not less than 24 inches in diameter in order to keep the excavated rock stable during high water flow. Also the excavated rock left in the channel should be large enough in size that it will not wash away during high water flow. Additional boulders should be placed in the channelized portion, at reasonable intervals, to provide maximum benefit for benthic habitat diversity.

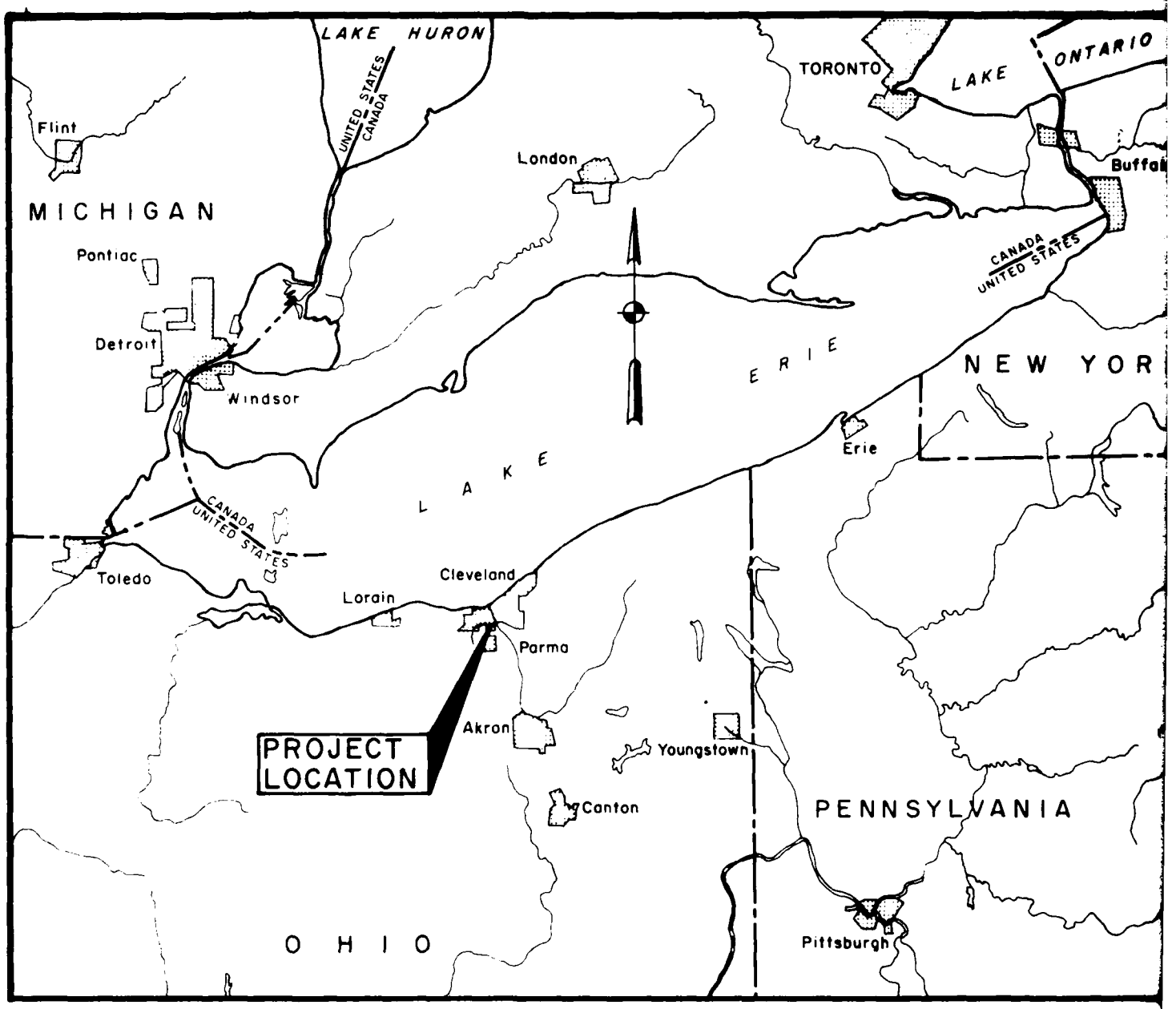
If we can be of further assistance in this matter, please let us know.

Sincerely yours,

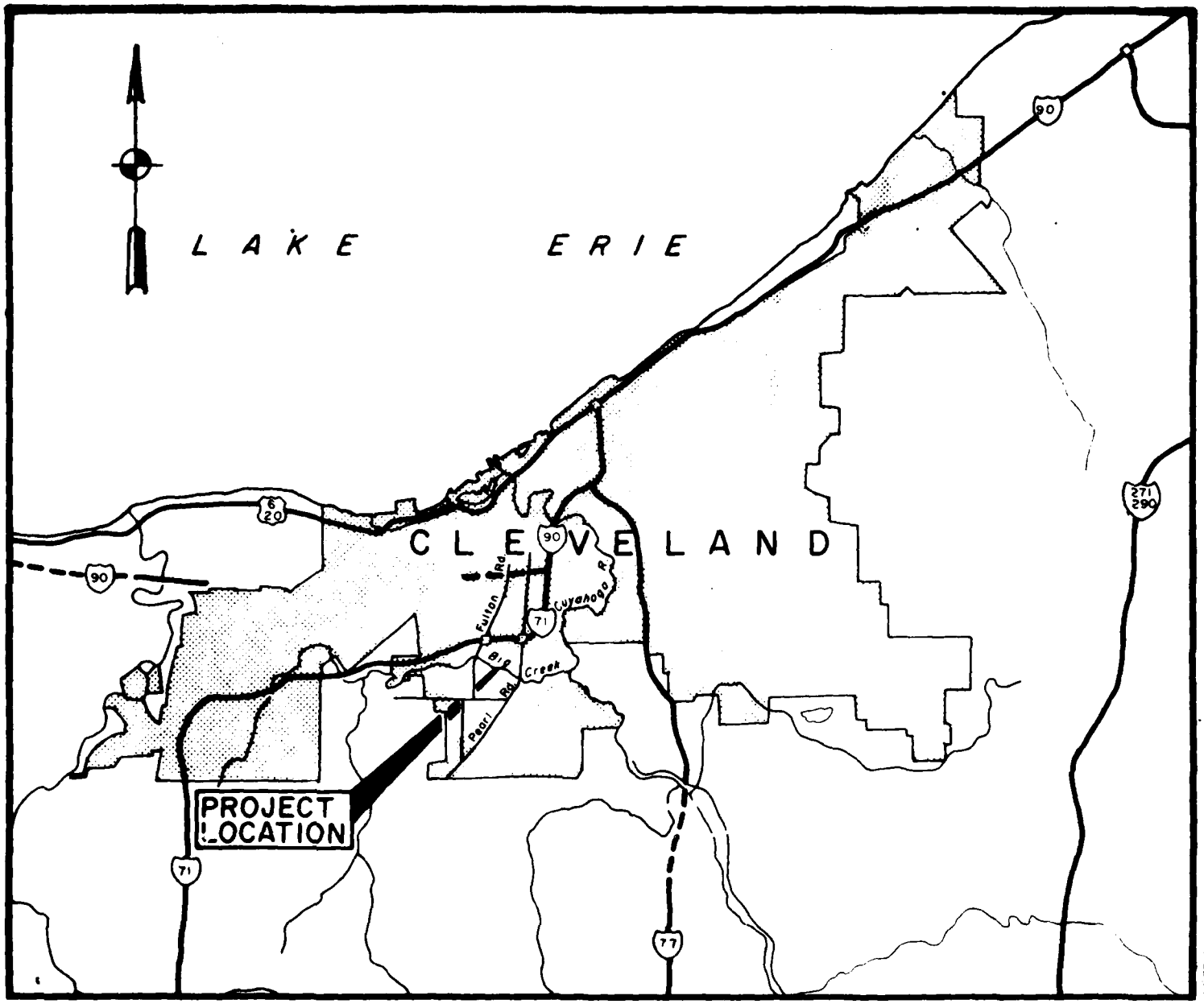
Conrad A. Fjetland
Supervisor

cc: Regional Administrator, U.S. EPA, Federal Activities Br., Chicago, IL
ODNR, Outdoor Recreation Serv., Attn: Mike Colvin, Columbus, OH
Regional Director, FWS, Twin Cities, MN (LWR)
Area Manager, FWS, East Lansing, MI (ES)

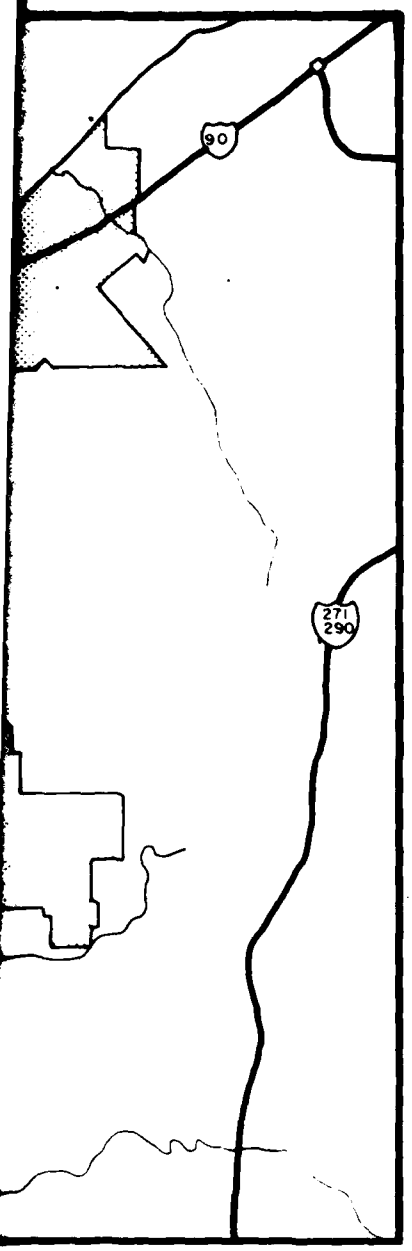
FILE COPY
Checked by
Filed by



LOCATION MAP



VICINITY MAP



TO ACCOMPANY PHASE II GDM

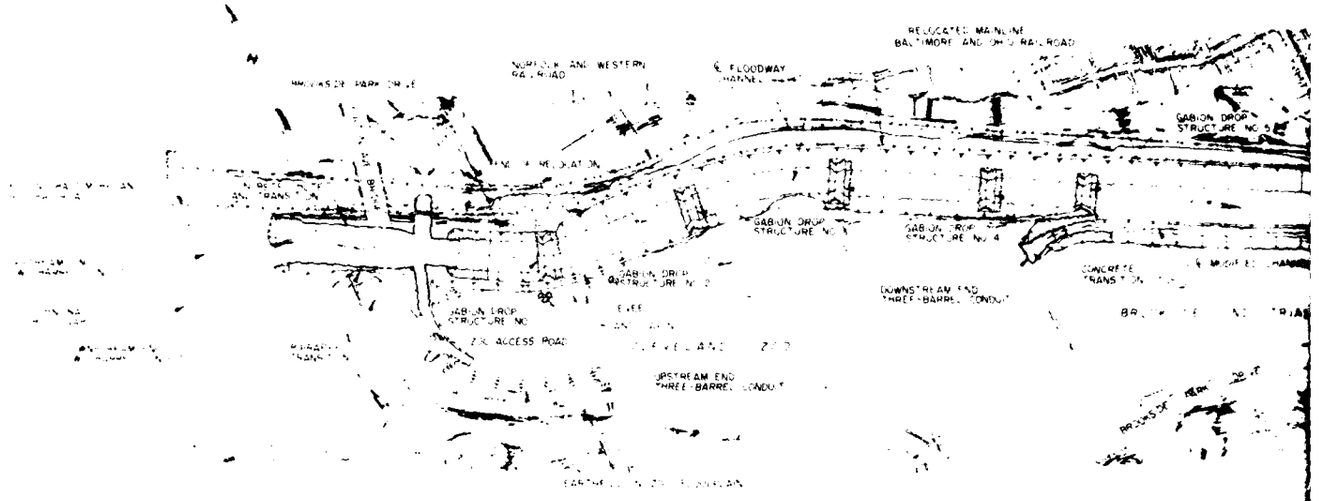
U. S. ARMY ENGINEER DISTRICT, BUFFALO
CORPS OF ENGINEERS
BUFFALO, NEW YORK 14207

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

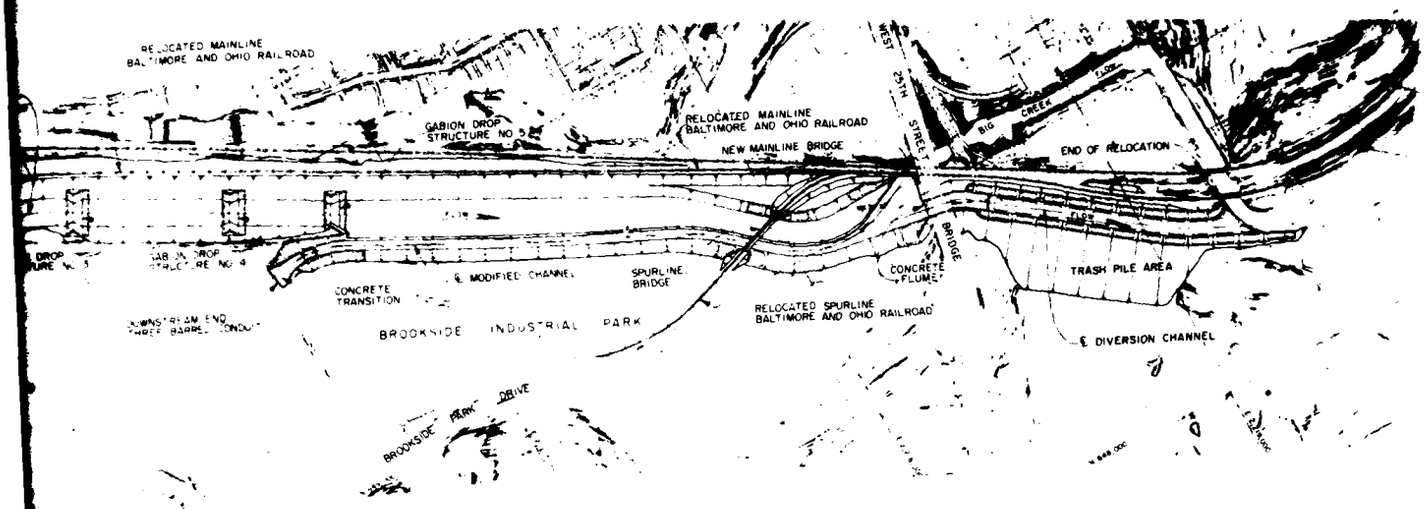
LOCATION AND VICINITY MAPS

GANNETT FLEMING CORDDRY AND CARPENTER, INC. CONSULTING ENGINEERS HARRISBURG, PA.	DRAWING NUMBER
SCALE: AS SHOWN	DATE: MARCH 1979 SHEET:

PLATE 1



GENERAL PLAN



GENERAL PLAN

TO ACCOMPANY PHASE II GDM

REV	DATE	DESCRIPTION

U.S ARMY ENGINEER DISTRICT, BUFFALO
CORPS OF ENGINEERS
BUFFALO, NEW YORK 14207

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

GENERAL PLAN

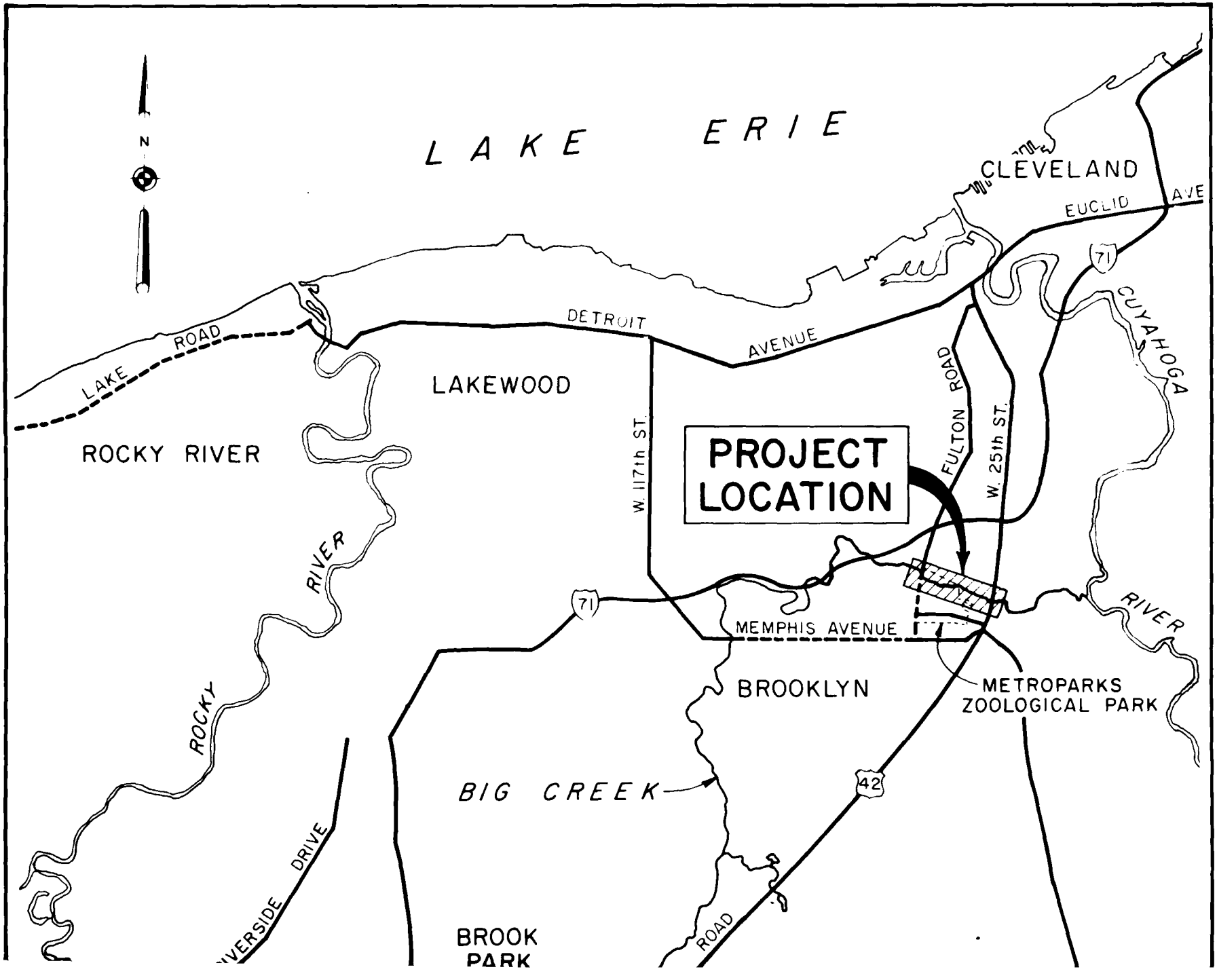
GANNETT FLEMING CORDDRY AND CARPENTER, INC
CONSULTING ENGINEERS
HARRISBURG, PA

DRAWING NUMBER

SCALE 1 IN = 200 FT | DATE MARCH 1979 | SHEET

2

PLATE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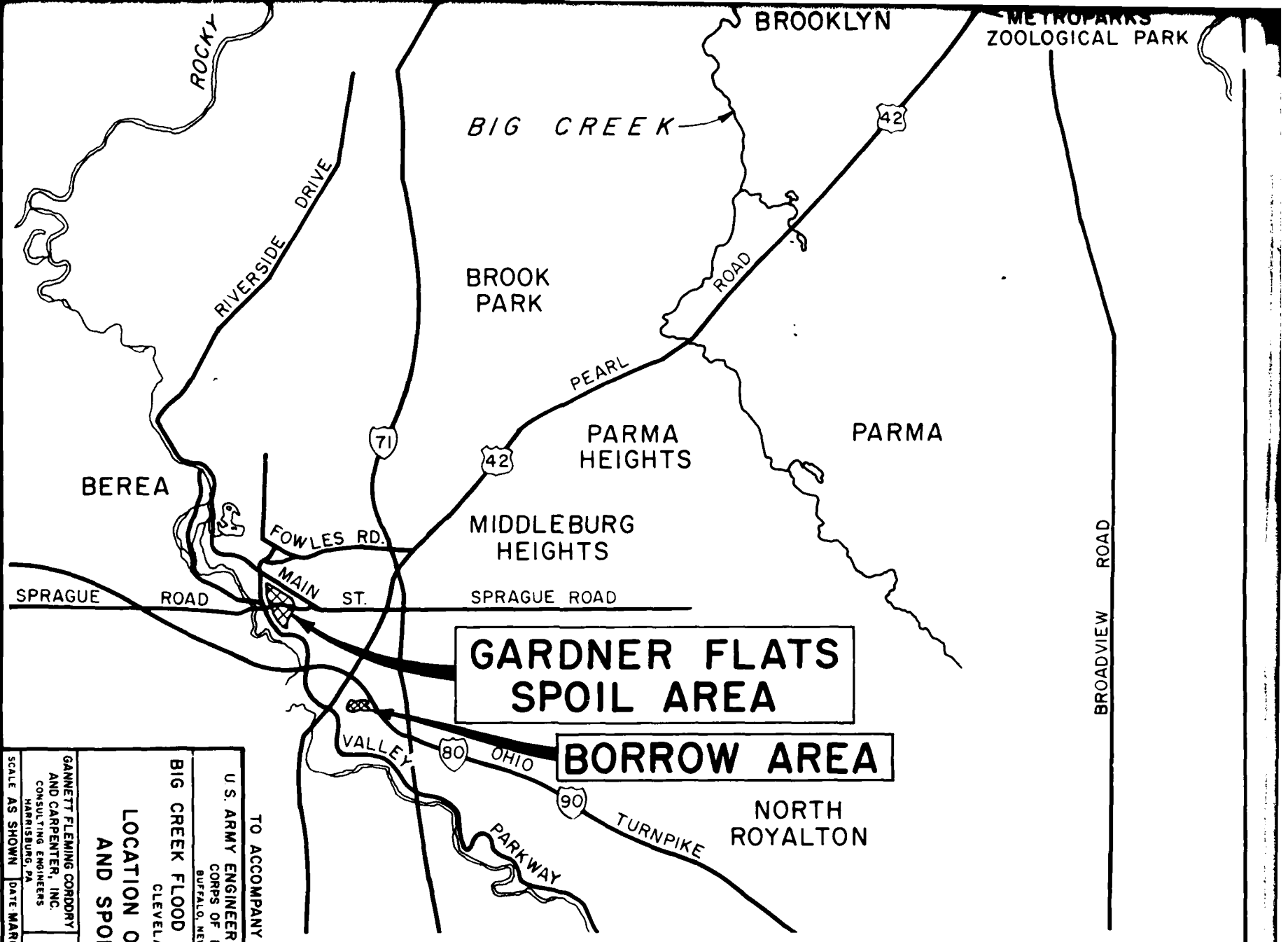
LAKE ERIE
CLEVELAND
EUCLID AVE
71
CUYAHOGA
DETROIT AVENUE
LAKE ROAD
LAKEWOOD
ROCKY RIVER
W. 117th ST.
FULTON ROAD
W. 25th ST.
PROJECT LOCATION
ROCKY RIVER
71
MEMPHIS AVENUE
BROOKLYN
METROPARKS ZOOLOGICAL PARK
BIG CREEK
42
RIVERSIDE DRIVE
BROOK PARK
ROAD



TO ACCOMPANY PHASE II GDM

U.S. ARMY ENGINEER DISTRICT, BUFFALO
CORPS OF ENGINEERS
BUFFALO, NEW YORK 14207

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

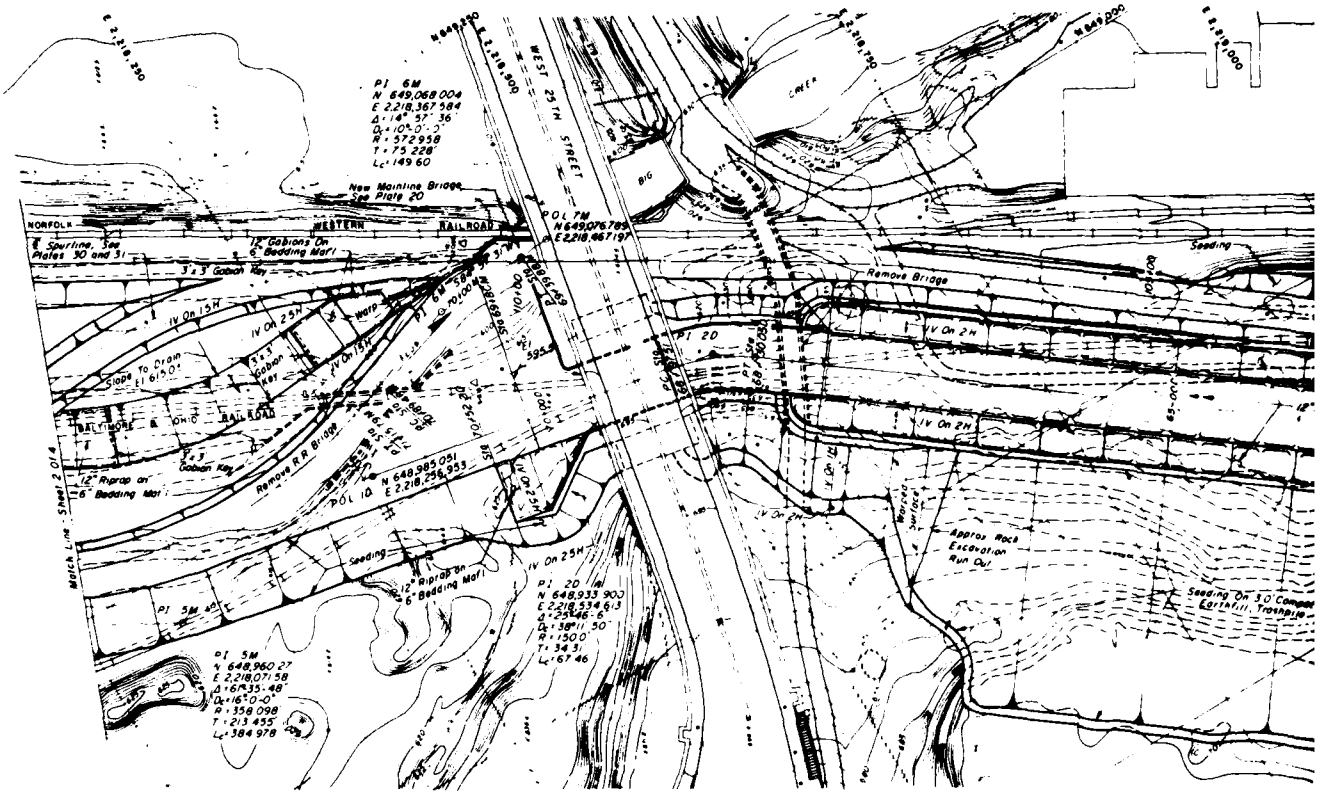
LOCATION OF BORROW
AND SPOIL AREAS

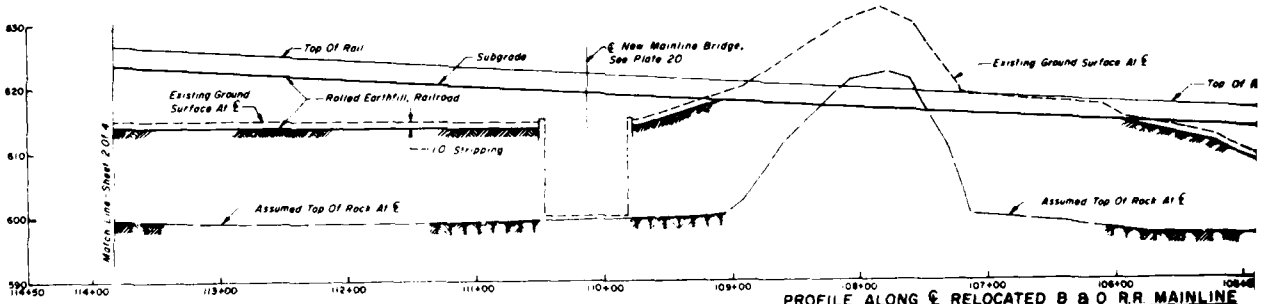
GANNETT FLEMING CORDDRY
AND CARPENTER, INC.
CONSULTING ENGINEERS
HARRISBURG, PA.

DRAWING NUMBER

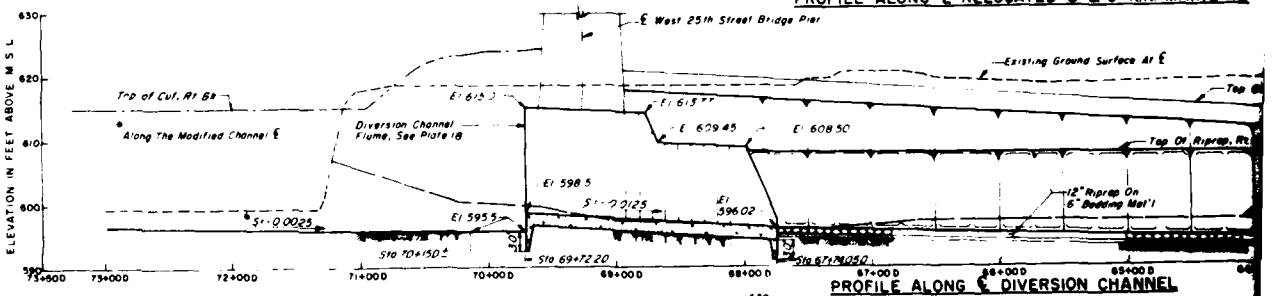
SCALE AS SHOWN | DATE MARCH 1979 | SHEET

PLATE 2

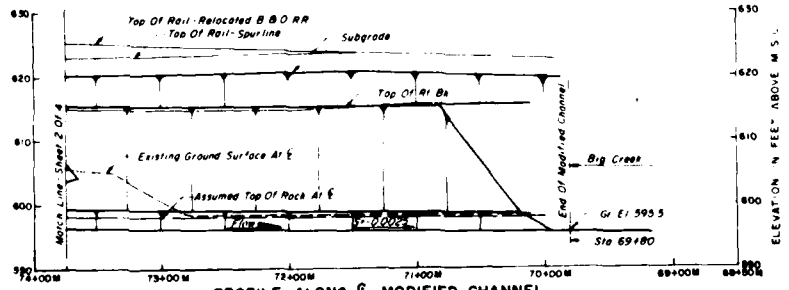




PROFILE ALONG ℄ RELOCATED B & O R.R. MAINLINE



PROFILE ALONG ℄ DIVERSION CHANNEL

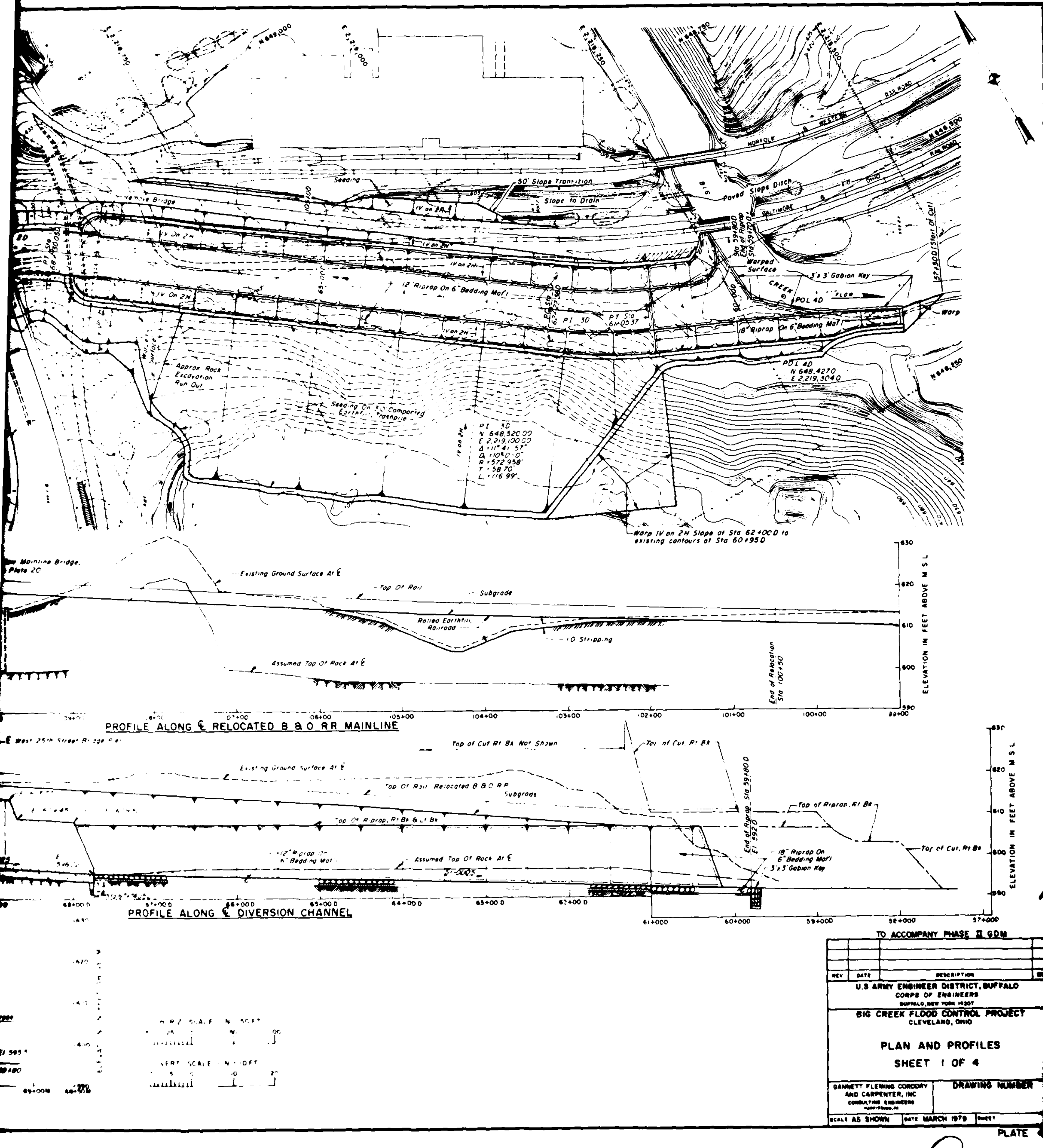


PROFILE ALONG ℄ MODIFIED CHANNEL

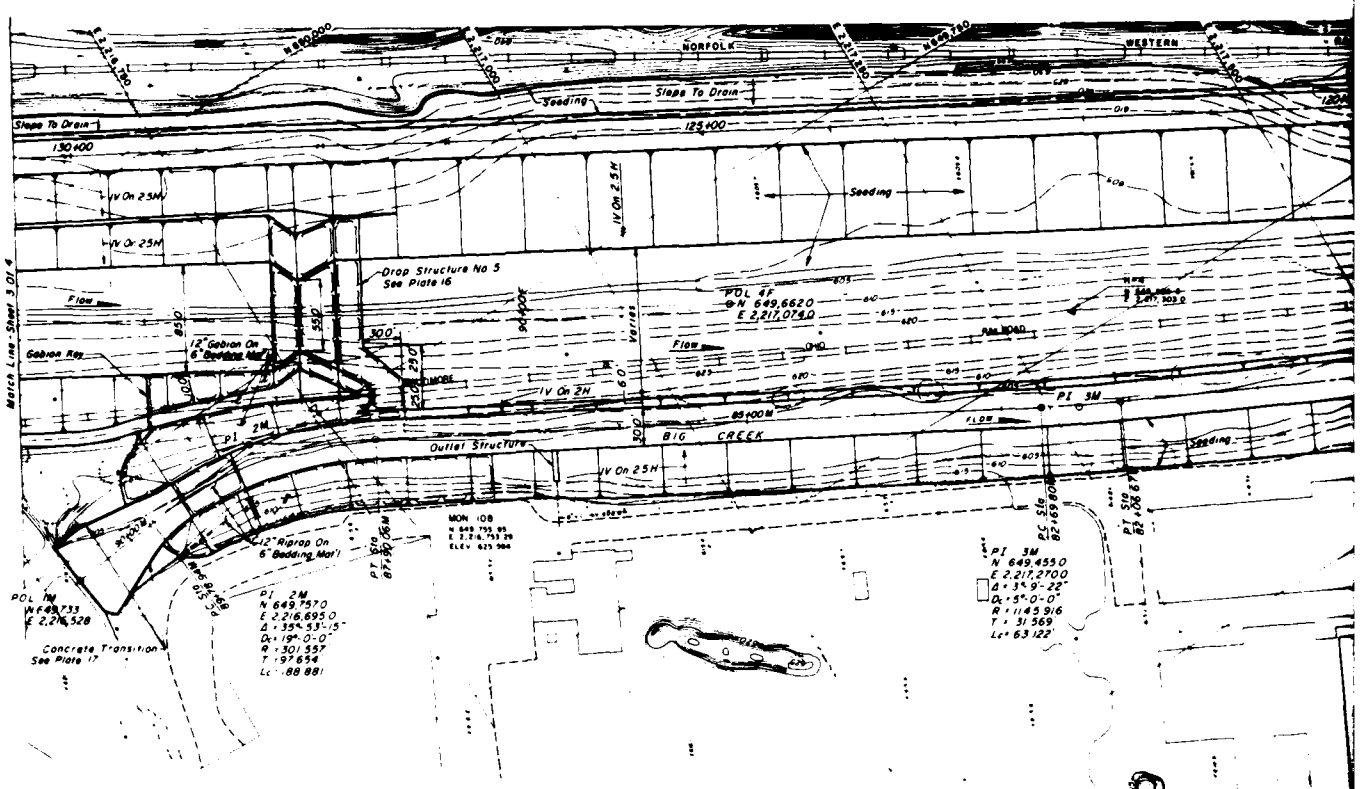
HORIZ SCALE 1 IN = 50 FT
50 25 0 50 100

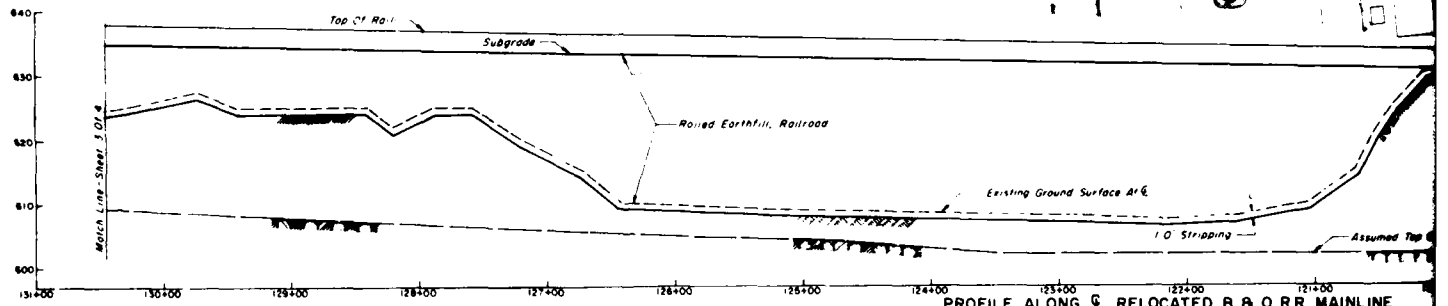
VERT SCALE 1 IN = 10 FT
10 5 0 10 20

PROFILES

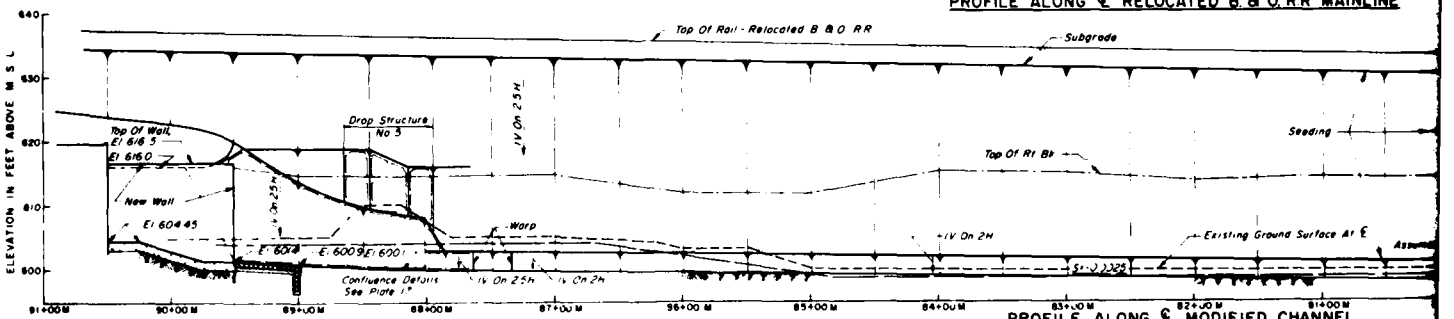


Seeding
50' Slope Transition
Slope to Drain
Paved Slope Ditch
NORFOLK & WESTERN RAILROAD
BALTIMORE & OHIO RAILROAD
Warped Surface
3'x 3' Gabion Key
CREEK
POL 4D
FLOW
Warp
12" Riprap On 6" Bedding Mat'l
18" Riprap On 6" Bedding Mat'l
1V on 2H
POL 4D N 648,4270 E 2,219,3040
Approx. Rock Excavation Run Out
Seeding On Compacted Earthfill Trashpile
PI 30 N 648,520.00 E 2,219,100.00
PT Sta 61+05.37
57+50.0 (Start of Cut)
Warp 1V on 2H Slope at Sta 62+00.0 to existing contours at Sta 60+95.0
Mainline Bridge, Plate 20
Existing Ground Surface At ℄
Top Of Rail
Subgrade
Rolled Earthfill, Railroad
10 Stripping
Assumed Top Of Rock At ℄
End of Relocation Sta 100+50
ELEVATION IN FEET ABOVE M S L
PROFILE ALONG ℄ RELOCATED B & O RR MAINLINE
℄ West 25th Street Bridge
Top of Cut Rt Bk Not Shown
Top of Cut, Rt Bk
Existing Ground Surface At ℄
Top Of Rail Relocated B & O RR
Subgrade
Top Of Riprap, Rt Bk & Lt Bk
Top of Riprap, Rt Bk
End of Riprap Sta 59+80.0 El 592.0
12" Riprap On 6" Bedding Mat'l
Assumed Top Of Rock At ℄
18" Riprap On 6" Bedding Mat'l
3'x 3' Gabion Key
Top of Cut, Rt Bk
PROFILE ALONG ℄ DIVERSION CHANNEL
HORZ SCALE IN FEET
VERT SCALE IN FEET
TO ACCOMPANY PHASE II GDM
REV | DATE | DESCRIPTION
U.S. ARMY ENGINEER DISTRICT, BUFFALO
CORPS OF ENGINEERS
BUFFALO, NEW YORK 14207
BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO
PLAN AND PROFILES
SHEET 1 OF 4
GANNETT FLEMING CORDDRY AND CARPENTER, INC
CONSULTING ENGINEERS
DRAWING NUMBER
SCALE AS SHOWN
DATE MARCH 1979
PLATE
2

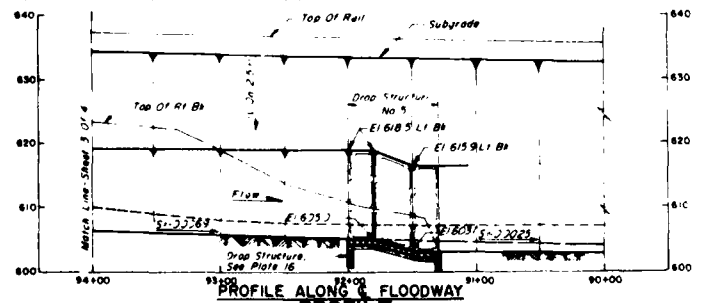




PROFILE ALONG ℄ RELOCATED B & O RR MAINLINE



PROFILE ALONG ℄ MODIFIED CHANNEL

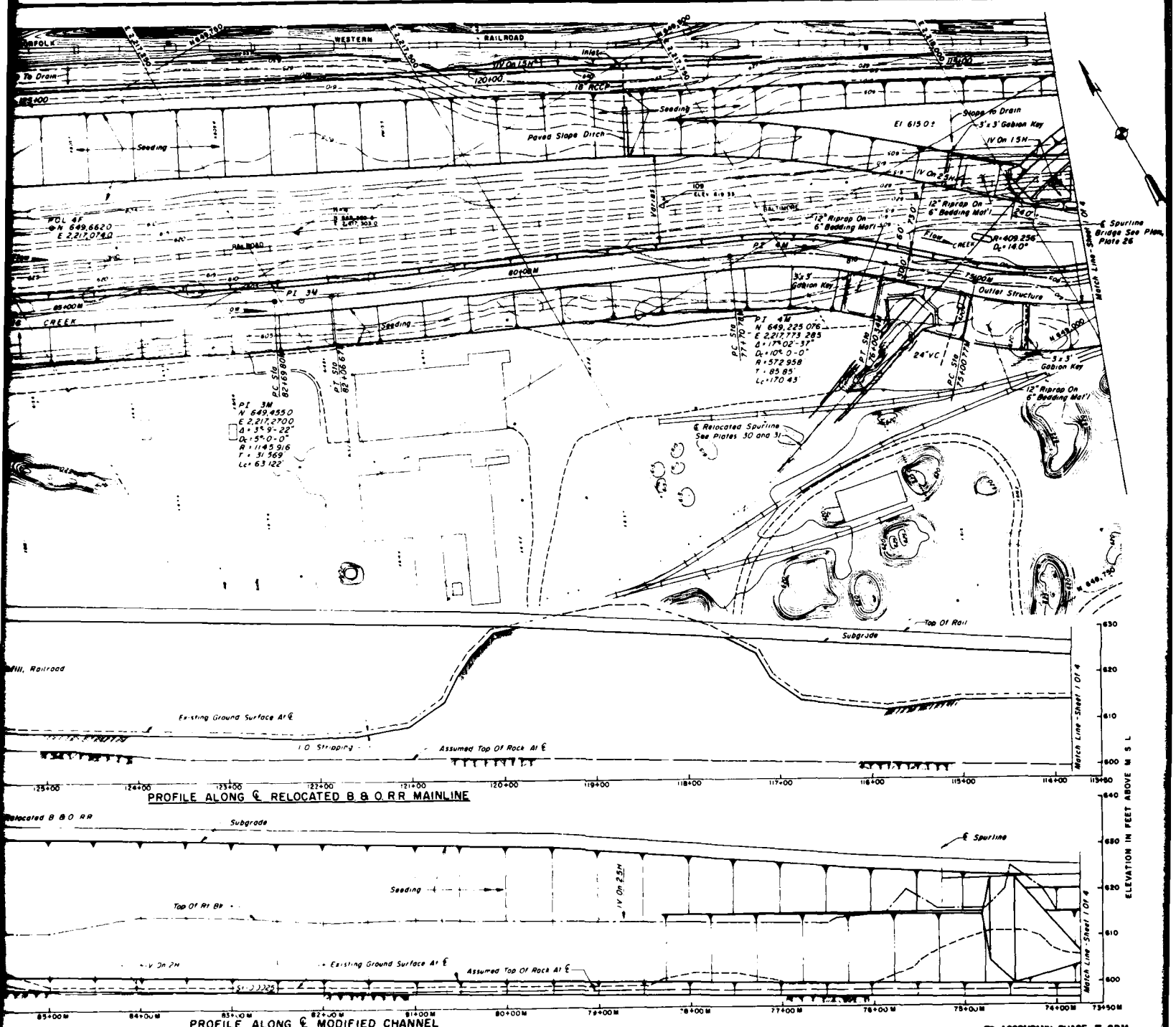


PROFILE ALONG ℄ FLOODWAY

HORIZ SCALE 1 IN = 50 FT
50 25 0 50 100

VERT SCALE 1 IN = 10 FT
0 5 0 10 20

PROFILE



PROFILE ALONG ℄ RELOCATED B & O R R MAINLINE

PROFILE ALONG ℄ MODIFIED CHANNEL

HORIZ SCALE 1 IN = 50 FT
90 25 0 50 100

VERT SCALE 1 IN = 10 FT
10 5 0 10 20

TO ACCOMPANY PHASE II GDM

REV	DATE	DESCRIPTION

U.S. ARMY ENGINEER DISTRICT, BUFFALO
CORPS OF ENGINEERS
BUFFALO, NEW YORK 14207

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

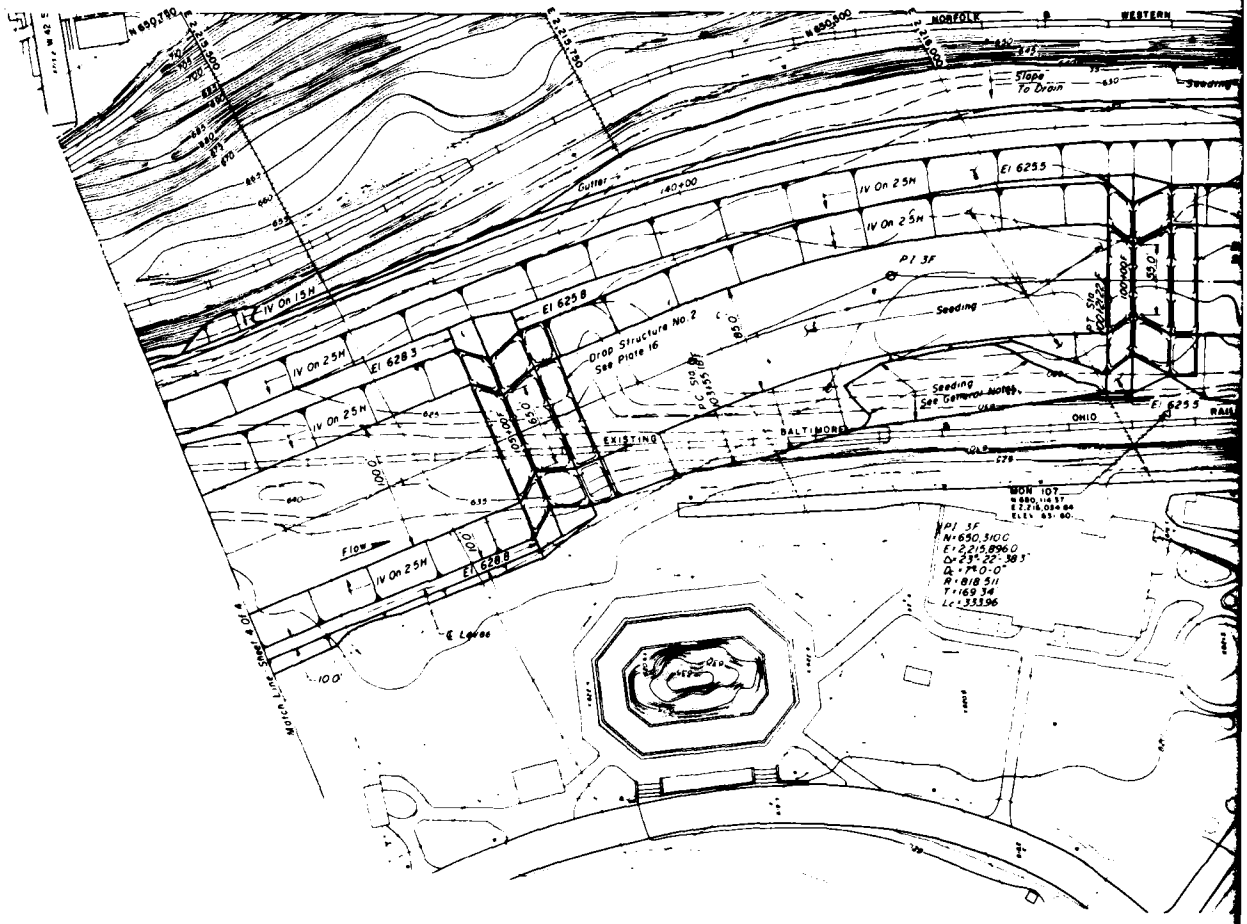
PLAN AND PROFILES
SHEET 2 OF 4

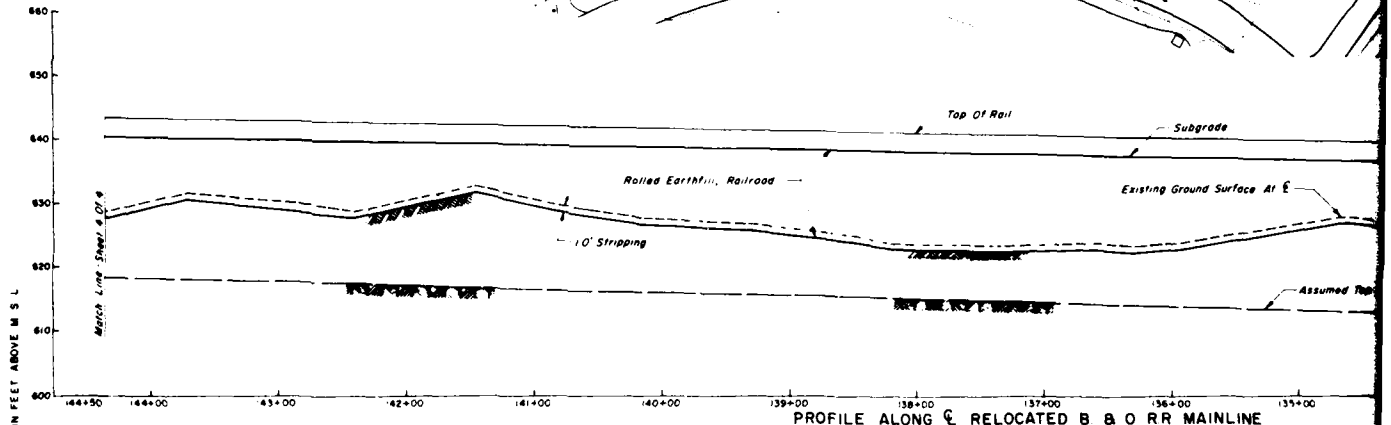
GANNETT FLEMING CORDDRY AND CARPENTER, INC.
CONSULTING ENGINEERS
HARRISBURG, PA.

DRAWING NUMBER

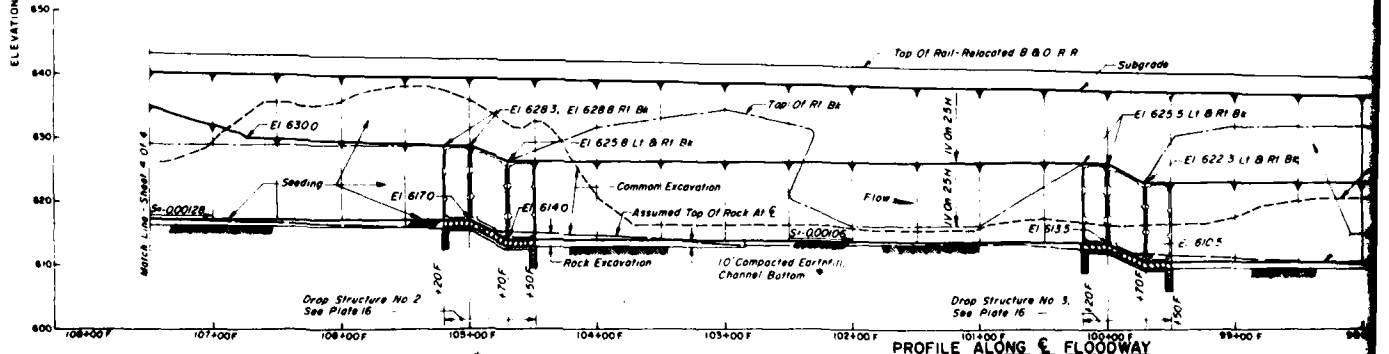
SCALE AS SHOWN | DATE MARCH 1979 | SHEET

PLATE 2





PROFILE ALONG ℄ RELOCATED B & O RR MAINLINE



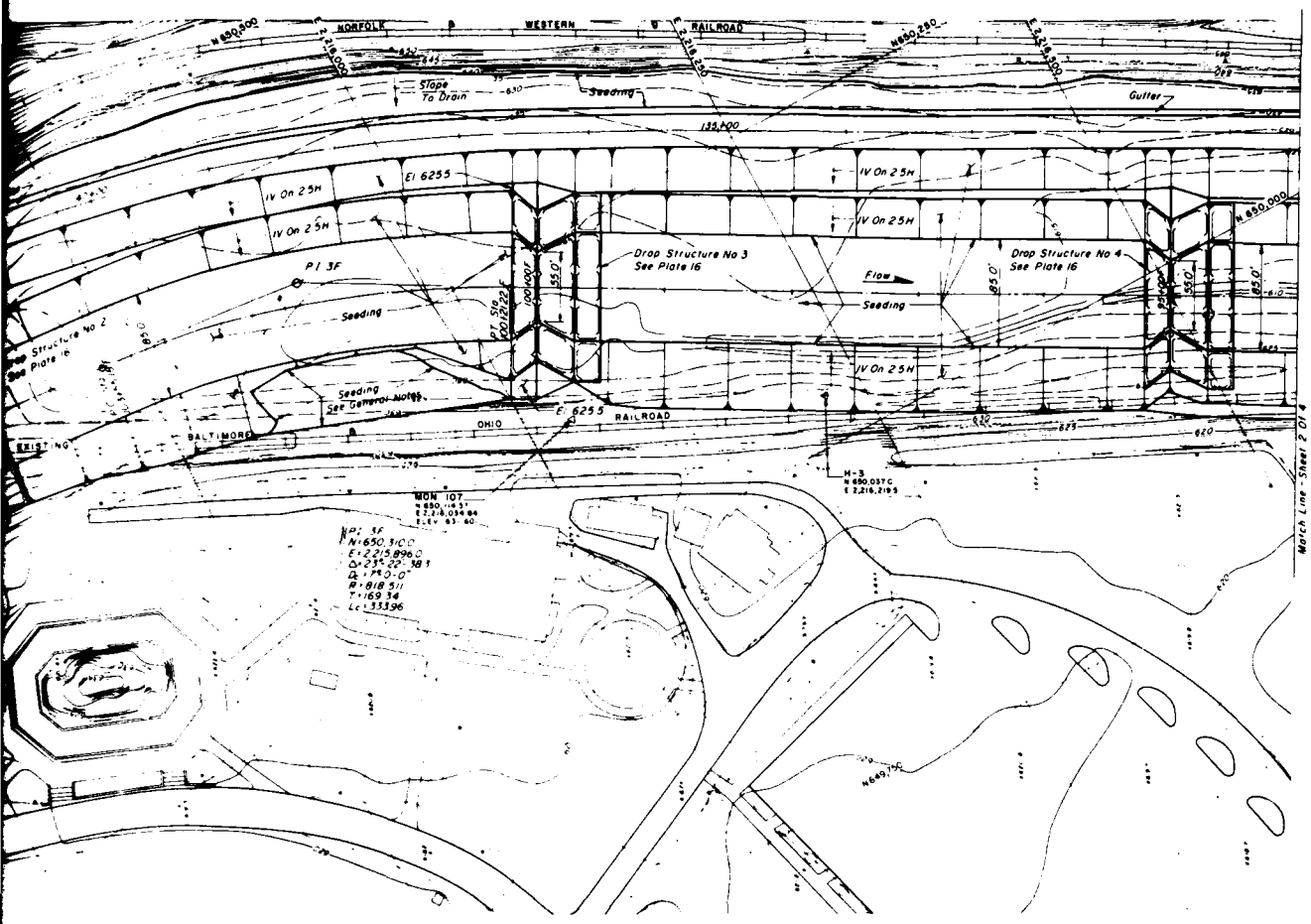
PROFILE ALONG ℄ FLOODWAY

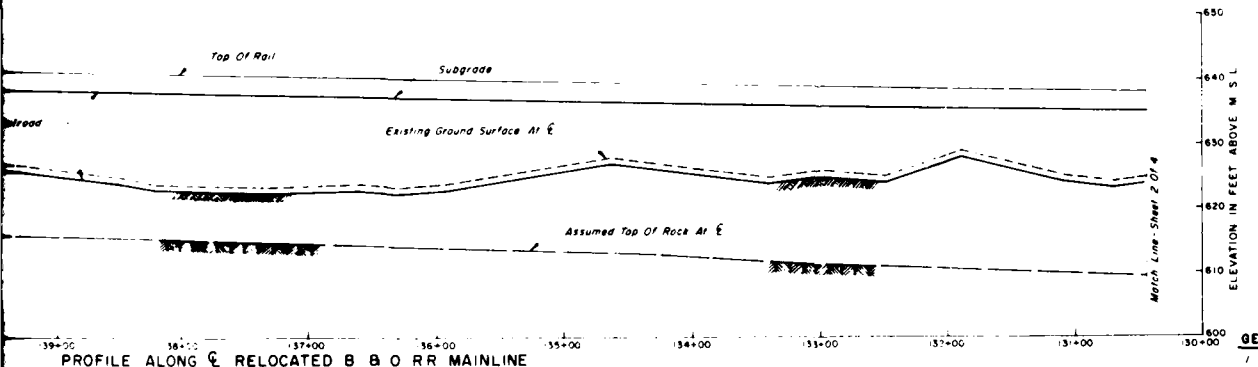
* Typical where top of rock is above grade line

PROFILES

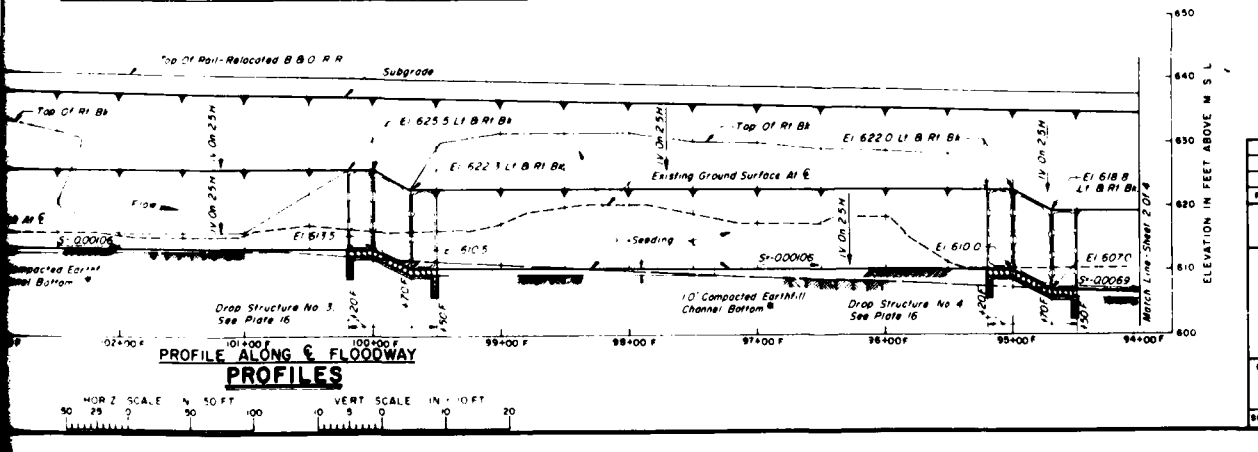
HORIZ SCALE 1 IN = 50 FT

VERT SCALE 1 IN = 10 FT





PROFILE ALONG ℄ RELOCATED B & O RR MAINLINE



PROFILE ALONG ℄ FLOODWAY

PROFILES

HOR Z SCALE IN = 50 FT 50 25 0 50 100

VERT SCALE IN = 10 FT 10 5 0 10 20

GENERAL NOTES:

1. Right bank between approx Sta 100+20F and 102+50F shall be cleared, grubbed, graded and then seeded

TO ACCOMPANY PHASE II GDM

REV	DATE	DESCRIPTION	BY

U.S. ARMY ENGINEER DISTRICT, BUFFALO
CORPS OF ENGINEERS
BUFFALO, NEW YORK 14207

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

PLAN AND PROFILES
SHEET 3 OF 4

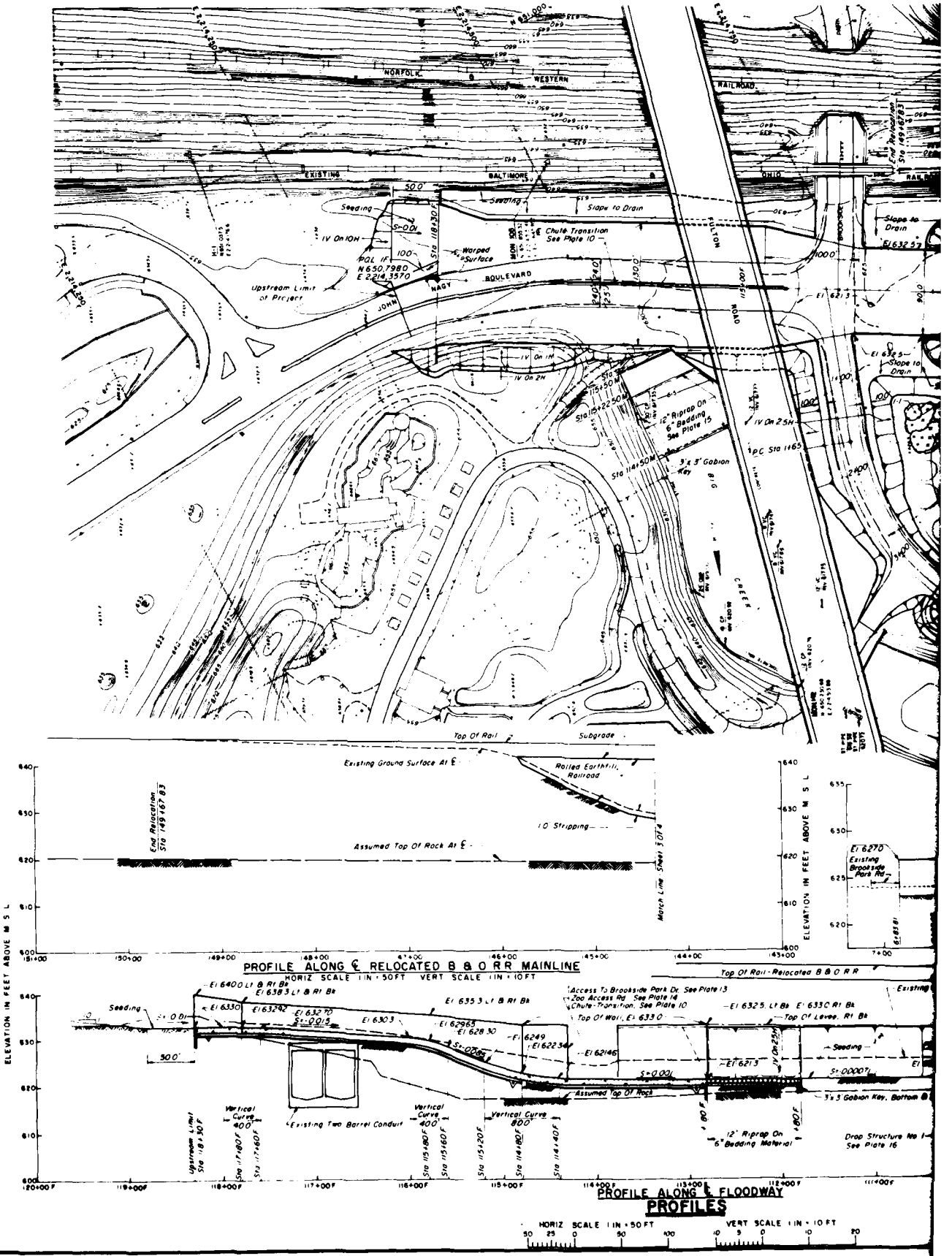
GANNETT FLEMING CORDDRY AND CARPENTER, INC
CONSULTING ENGINEERS
HARRISBURG, PA

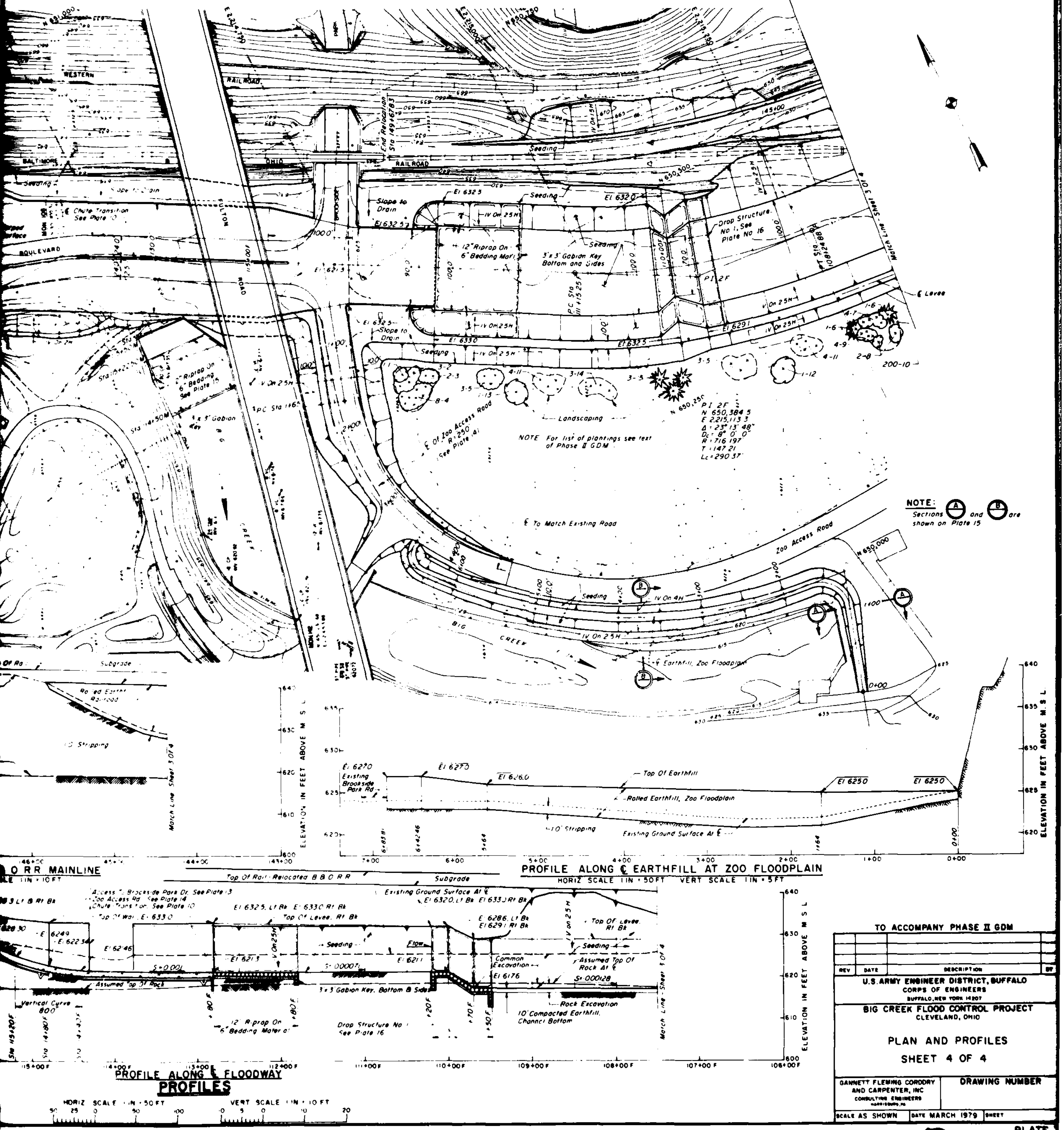
DRAWING NUMBER

SCALE AS SHOWN | DATE MARCH 1979 | SHEET

PLATE 6

2


NORFOLK & WESTERN RAILROAD
EXISTING
BALTIMORE & OHIO RAILROAD
Seeding
Slope to Drain
S=0.01
1V On 10H
Warped Surface
Chute Transition See Plate 10
POL 1F
N 650,798.0
E 2214,357.0
Upstream Limit of Project
JOHN NAGY BOULEVARD
1V On 1H
1V On 2H
1V On 2.5H
12" Riprap On 6" Bedding See Plate 15
3'x 3' Gabion Key
P.C. Sta 1165
End Relocation Sta 149+67.83
Top Of Rail
Subgrade
Existing Ground Surface At ℄
Rolled Earthfill, Railroad
10' Stripping
Assumed Top Of Rock At ℄
Match Line Sheet 3 Of 4
ELEVATION IN FEET ABOVE M S L
PROFILE ALONG ℄ RELOCATED B & O R R MAINLINE
HORIZ SCALE 1 IN = 50 FT VERT SCALE 1 IN = 10 FT
Top Of Rail - Relocated B & O R R
Access To Brookside Park Dr. See Plate 13
Zoo Access Rd. See Plate 14
Chute Transition See Plate 10
Top Of Wall, El 633.0
Top Of Levee, Rt Bk
Existing Two Barrel Conduit
Vertical Curve 400'
Vertical Curve 800'
Assumed Top Of Rock
3'x 3' Gabion Key, Bottom @
12' Riprap On 6" Bedding Material
Drop Structure No 1 See Plate 16
PROFILE ALONG ℄ FLOODWAY
PROFILES
HORIZ SCALE 1 IN = 50 FT VERT SCALE 1 IN = 10 FT



TO ACCOMPANY PHASE II GDM

REV	DATE	DESCRIPTION	BY

U.S. ARMY ENGINEER DISTRICT, BUFFALO
CORPS OF ENGINEERS
BUFFALO, NEW YORK 14207

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

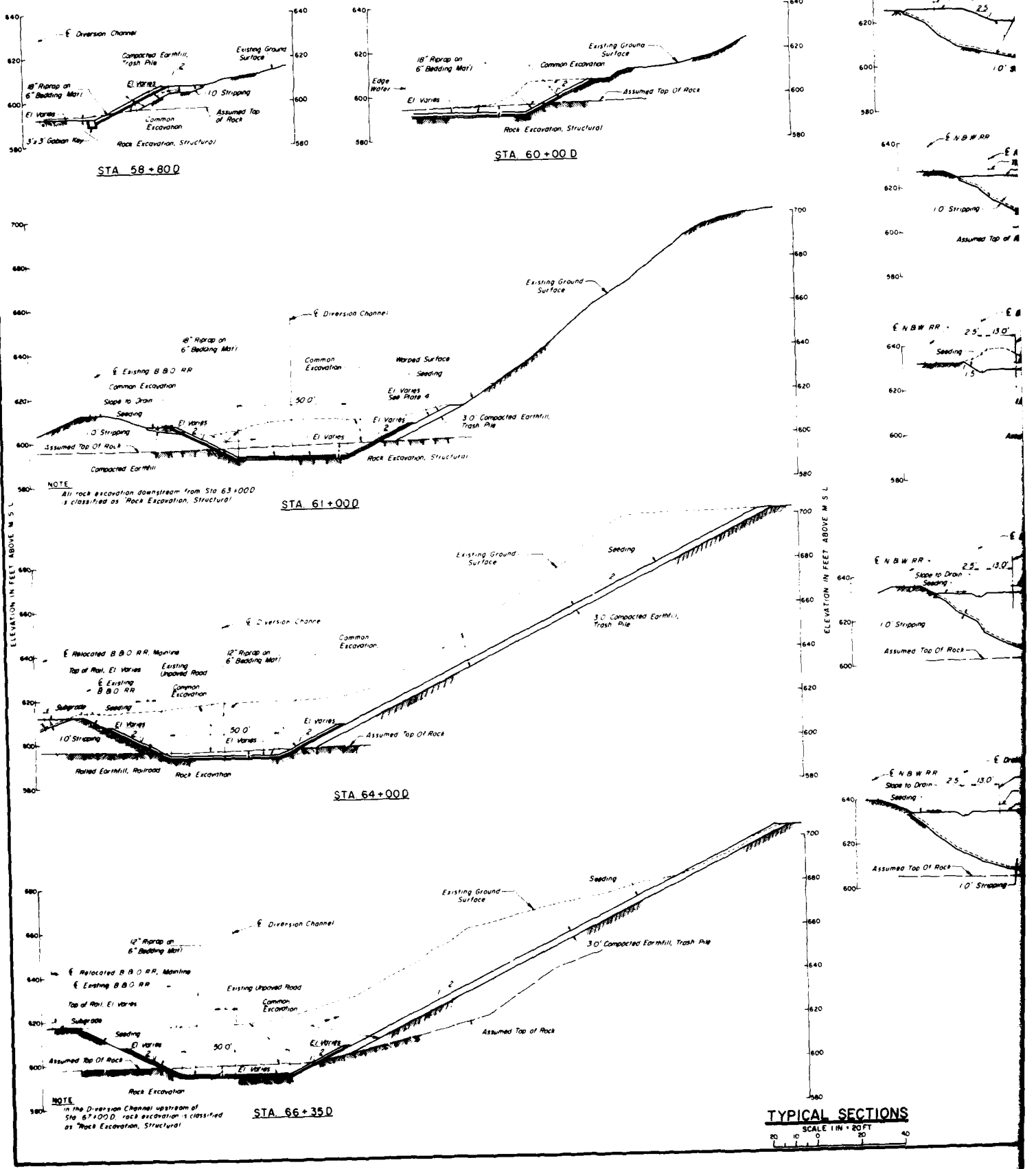
PLAN AND PROFILES
SHEET 4 OF 4

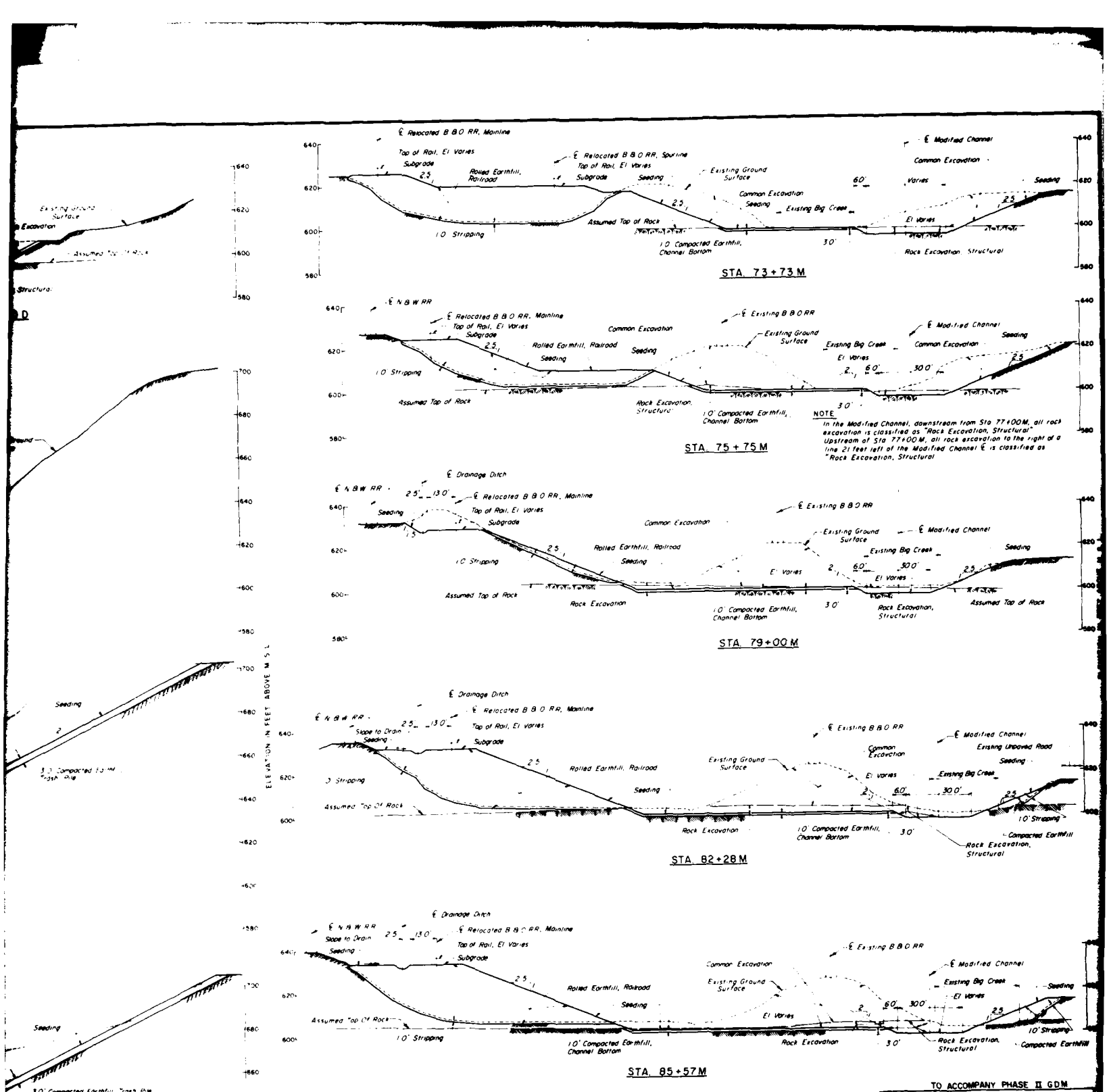
GANNETT FLEMING CORDDRY AND CARPENTER, INC
CONSULTING ENGINEERS
HARRISBURG, PA

DRAWING NUMBER

SCALE AS SHOWN | DATE MARCH 1979 | SHEET

PLATE 2


℄ Diversion Channel
Compacted Earthfill, Trash Pile
Existing Ground Surface
18" Riprap on 6" Bedding Mat'l
El Varies
1.0' Stripping
Common Excavation
Assumed Top of Rock
3'x3' Gabion Key
Rock Excavation, Structural
STA 58+80.0
Edge Water
Common Excavation
Assumed Top Of Rock
STA 60+00.0
Warped Surface
Seeding
℄ Existing B.B.O. RR
Slope to Drain
50.0'
El Varies See Plans
3.0' Compacted Earthfill, Trash Pile
Compacted Earthfill
NOTE
All rock excavation downstream from Sta 63+00.0 is classified as "Rock Excavation, Structural"
STA 61+00.0
℄ Relocated B.B.O. RR, Mainline
Top of Rail, El Varies
Existing Unpaved Road
12" Riprap on 6" Bedding Mat'l
Subgrade
Rolled Earthfill, Railroad
STA 64+00.0
Assumed Top of Rock
NOTE
In the Diversion Channel upstream of Sta 67+00.0, rock excavation is classified as "Rock Excavation, Structural"
STA 66+35.0
ELEVATION IN FEET ABOVE M.S.L.
℄ N.B.W. RR
2.5
13.0'
1.5
TYPICAL SECTIONS
SCALE 1 IN = 20 FT
20 10 0 20 40



GENERAL NOTES

1. Sections cut looking downstream
2. For drainage ditch and roadbed details of the relocated B & O R.R. mainline, See Plate 31
3. Slopes indicated slope to drain shall be 1/4" per foot
4. For Channels Plan and Profiles, See Plate 4 thru Plate 7
5. For B & O Relocated R.R. Plan and Profile, See Plate 30 and 31

TO ACCOMPANY PHASE II GDM

REV	DATE	DESCRIPTION

U.S ARMY ENGINEER DISTRICT, BUFFALO
CORPS OF ENGINEERS
BUFFALO, NEW YORK 14207

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

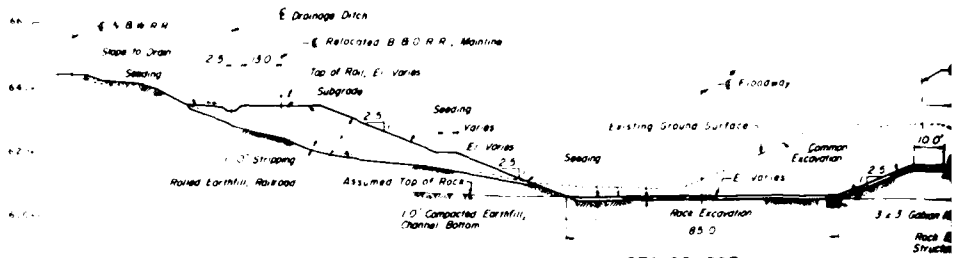
TYPICAL CHANNEL SECTIONS
SHEET 1 OF 2

GANNETT FLEMING CORDDRY AND CARPENTER, INC
CONSULTING ENGINEERS

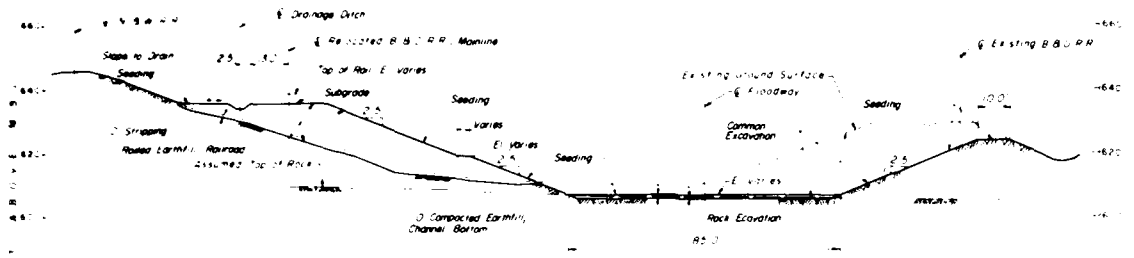
DRAWING NUMBER

SCALE AS SHOWN | DATE MARCH 1979 | SHEET

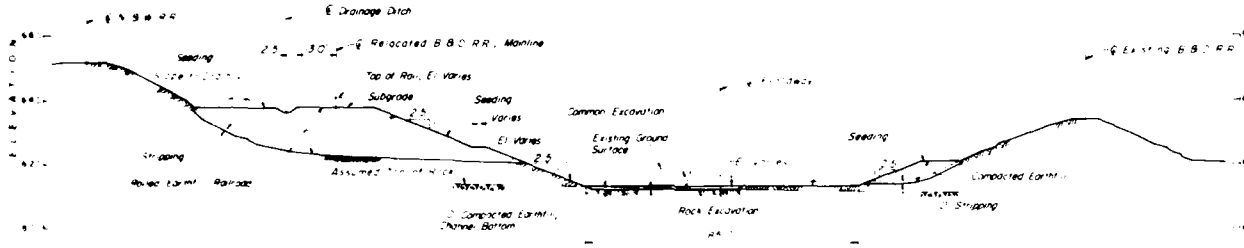
PLATE



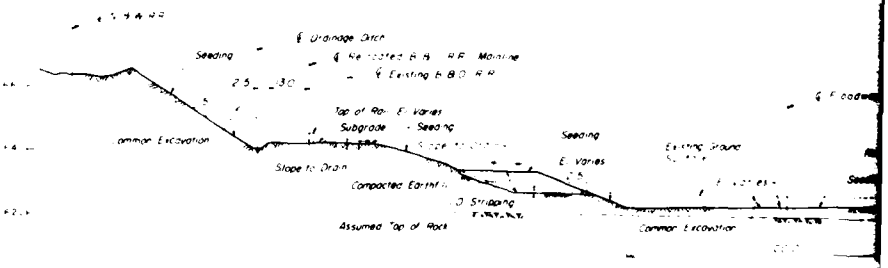
STA 92+50F



STA 94+50F



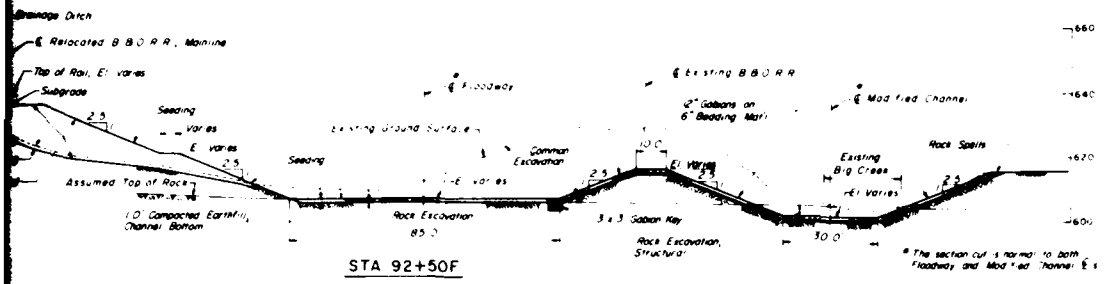
STA 100+50F



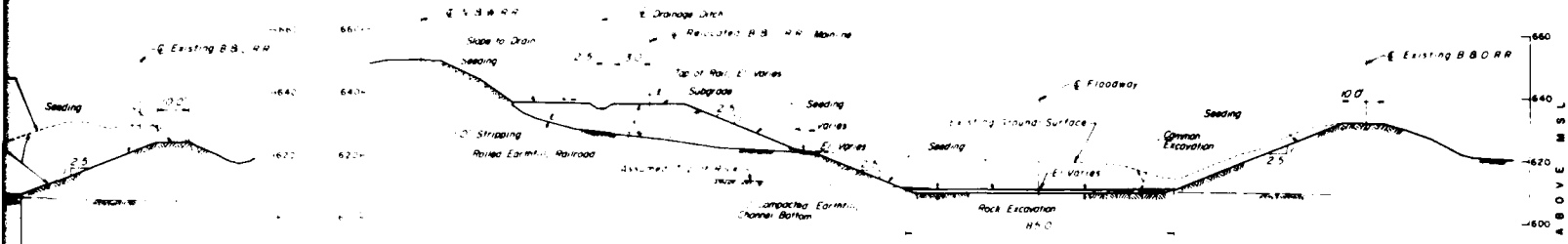
STA 110+50F

TYPICAL SECTIONS

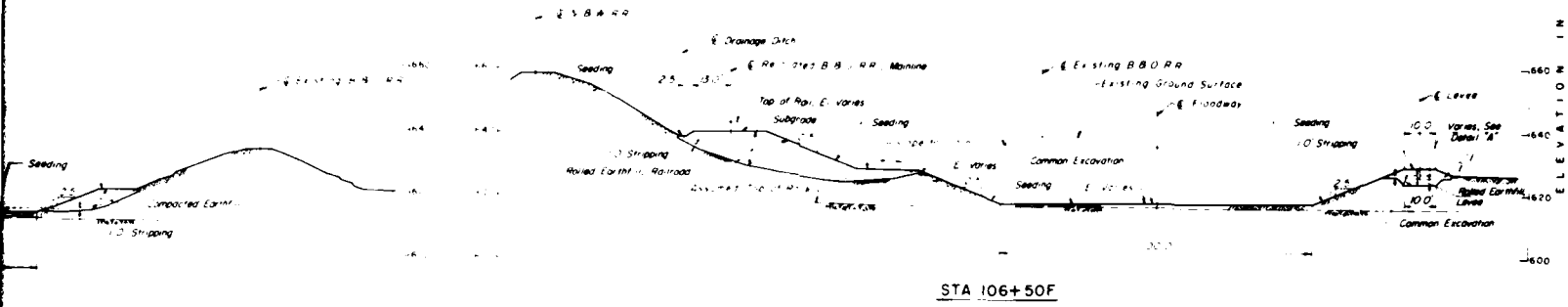
SCALE 1IN = 20FT



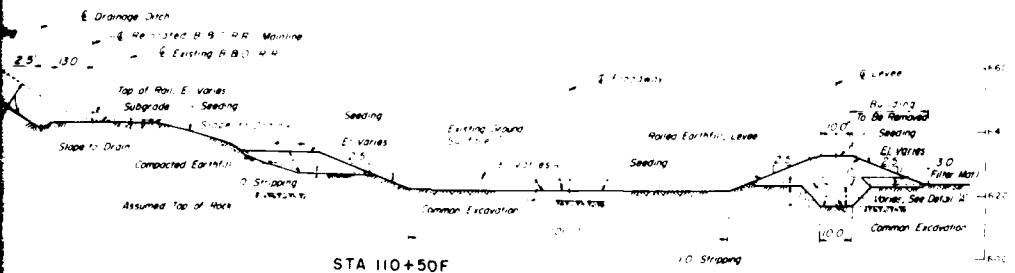
STA 92+50F



STA 98+50F



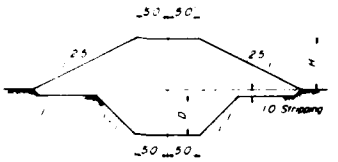
STA 106+50F



STA 110+50F

TYPICAL SECTIONS

SCALE 1 IN = 20 FT



H	D
60 or Greater	60
20 to 60	H
20 or Less	20

DETAIL "A"

DEPTH OF EXPLORATORY AND CUTOFF TRENCH

NOT TO SCALE

ELEVATION IN FEET ABOVE MSL

GENERAL NOTES

1. For General Notes, See Sheet 1 of 2

TO ACCOMPANY PHASE II GDM

REV	DATE	DESCRIPTION	BY

U.S ARMY ENGINEER DISTRICT, BUFFALO
CORPS OF ENGINEERS
BUFFALO, NEW YORK 14207

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

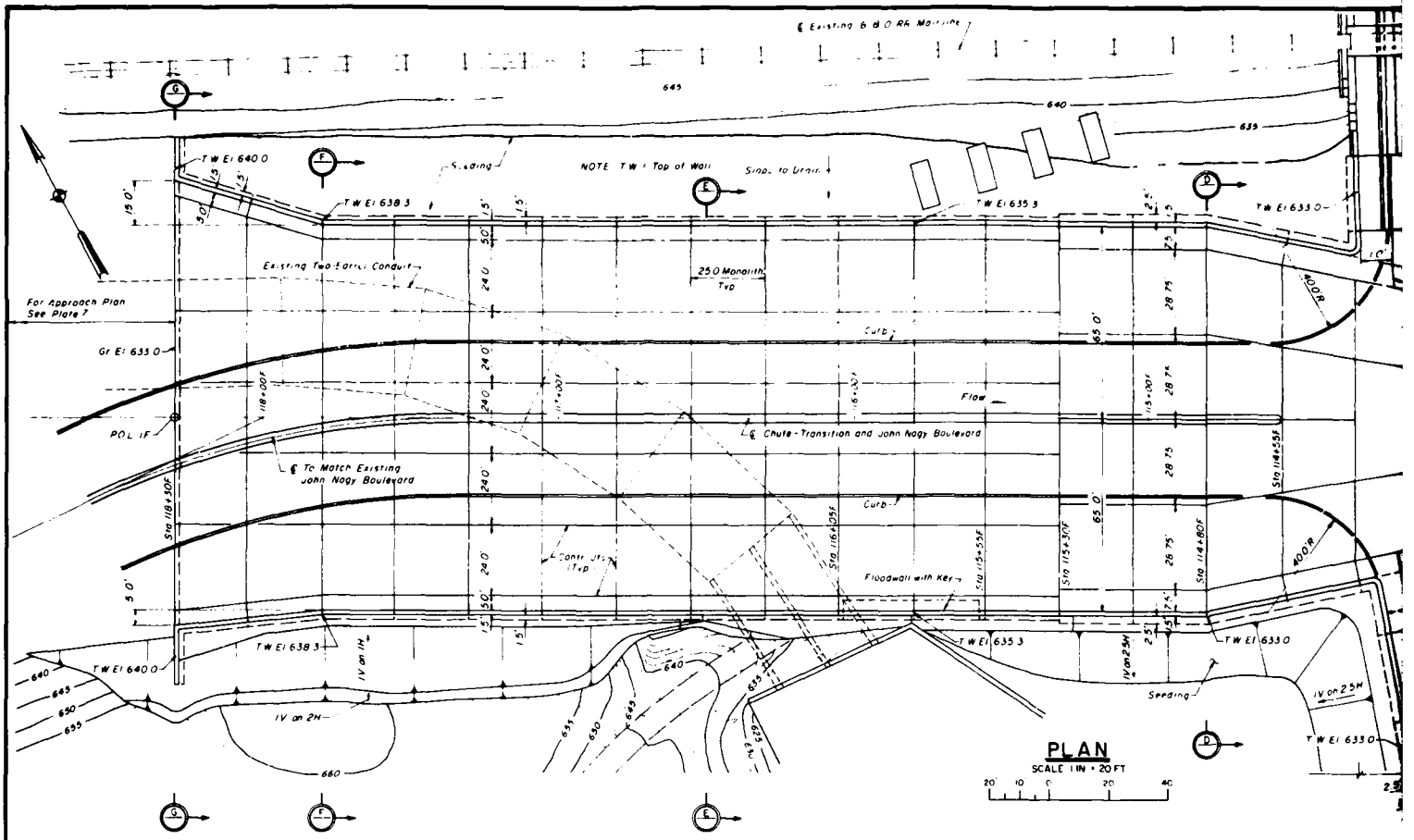
TYPICAL CHANNEL SECTIONS
SHEET 2 OF 2

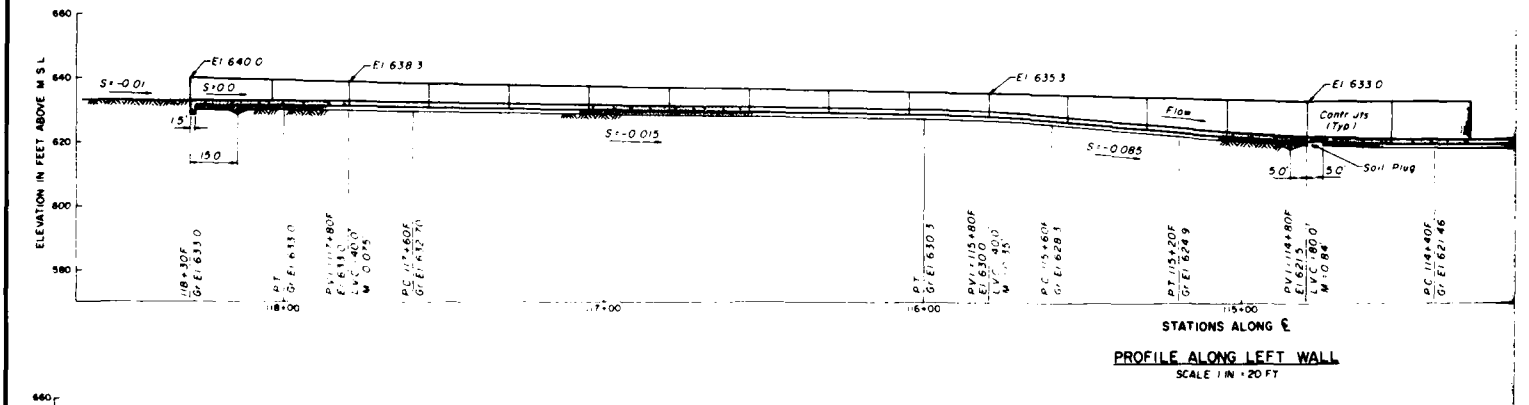
GANNETT FLEMING CORDDRY AND CARPENTER, INC
CONSULTING ENGINEERS

DRAWING NUMBER

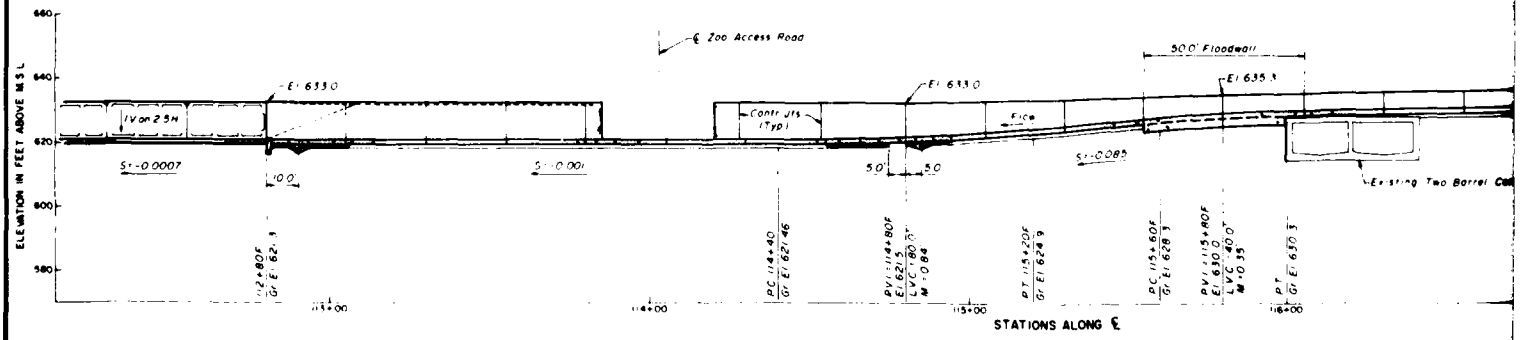
SCALE AS SHOWN | DATE MARCH 1979 | SHEET

PLATE 9

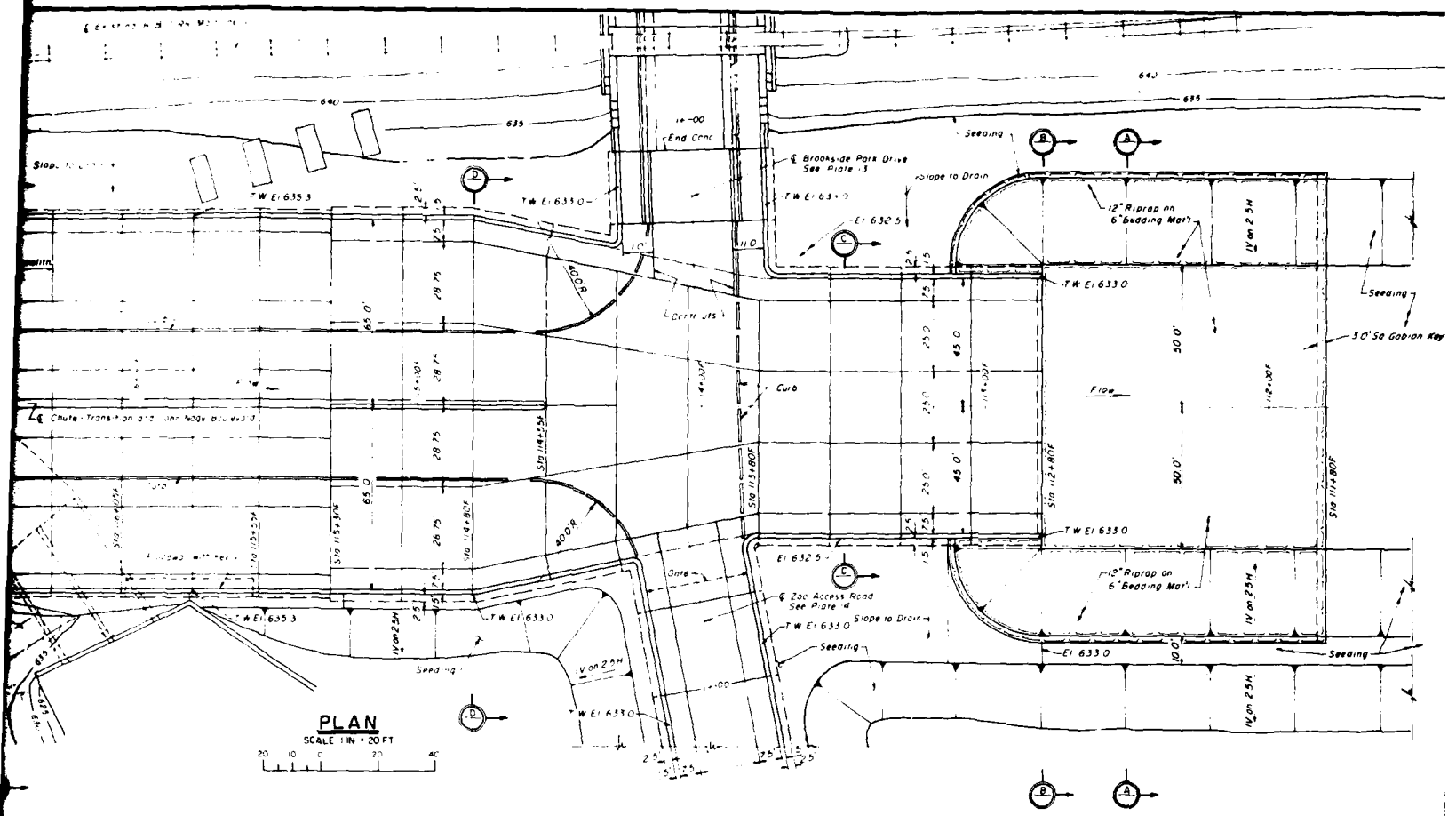


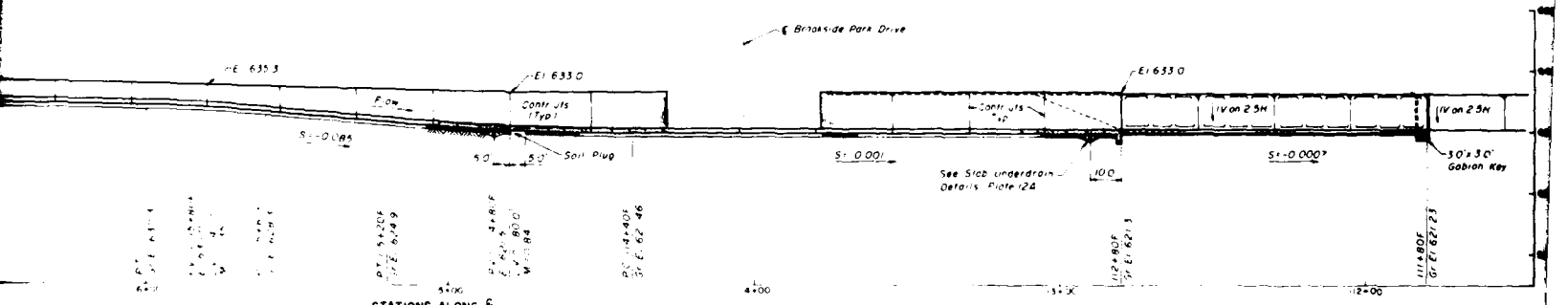


PROFILE ALONG LEFT WALL
SCALE 1 IN = 20 FT



PROFILE ALONG RIGHT WALL

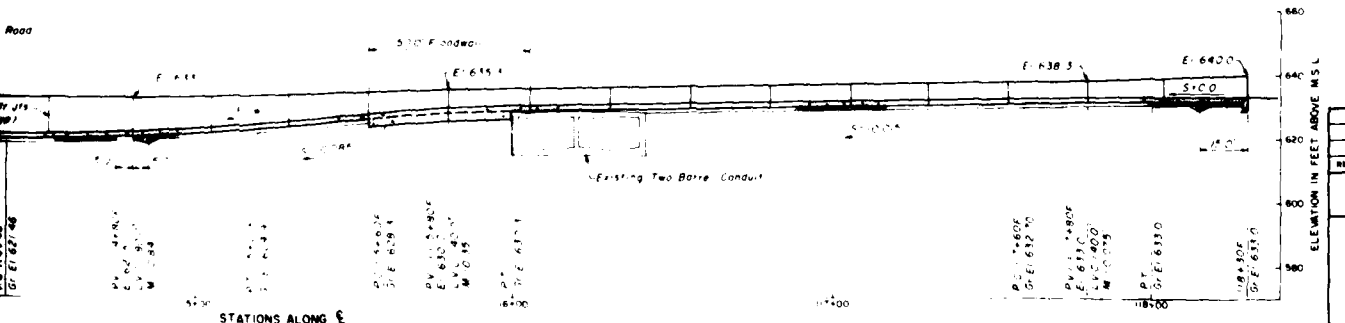




STATIONS ALONG ℄

PROFILE ALONG LEFT WALL

SCALE 1 IN = 20 FT



STATIONS ALONG ℄

PROFILE ALONG RIGHT WALL

GENERAL NOTES

1. Sections are shown on Plates 11 and 12.
2. For General Plan and Profile, see Plate 2.
3. Waterstop will be provided at all Contraction
4. For Subdrainage System, see Plate 12-A.

TO ACCOMPANY PHASE II GDM

REV	DATE	DESCRIPTION

U.S. ARMY ENGINEER DISTRICT, BUFFA
CORPS OF ENGINEERS
BUFFALO, NEW YORK 14207

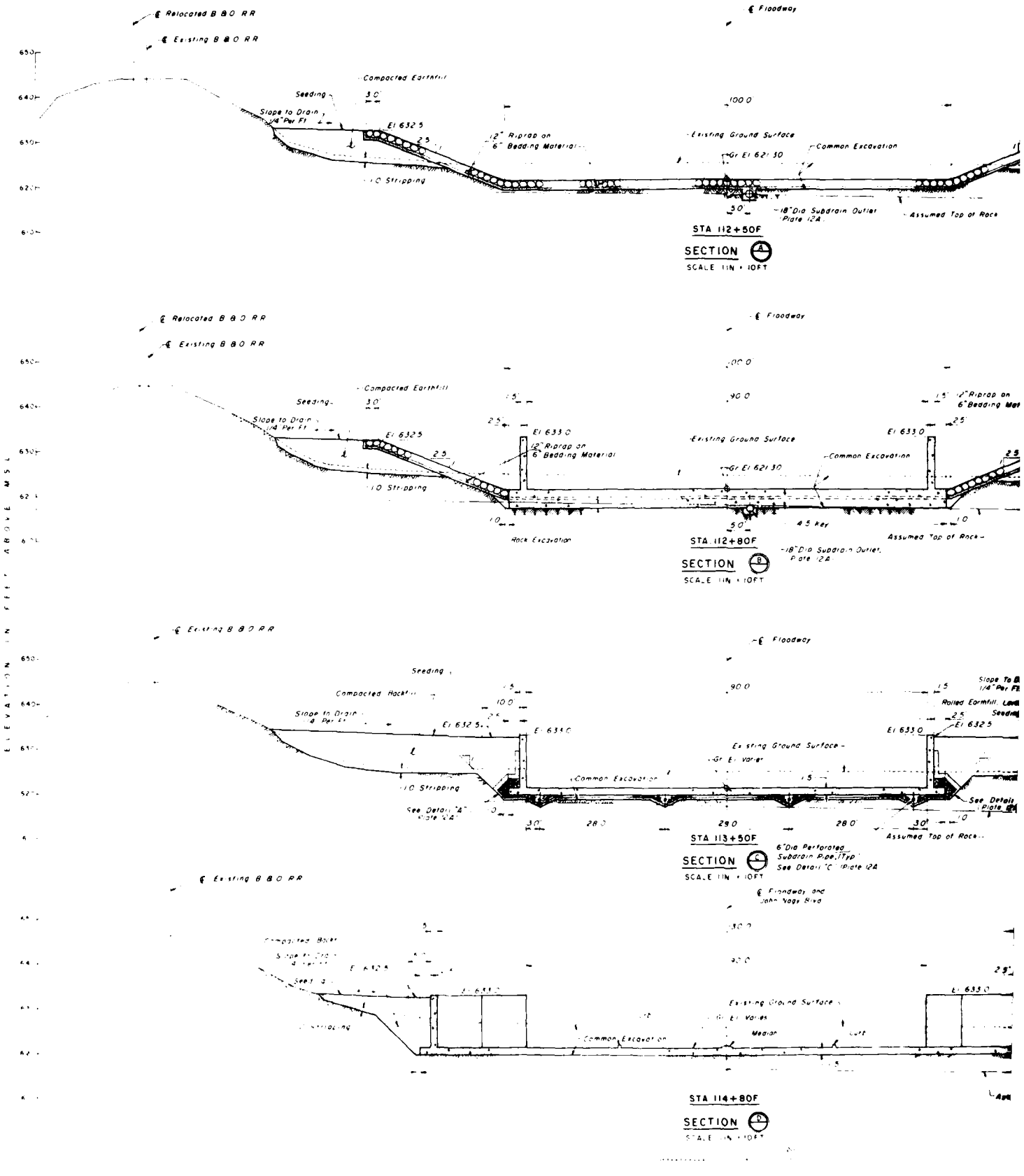
BIG CREEK FLOOD CONTROL PRO
CLEVELAND, OHIO

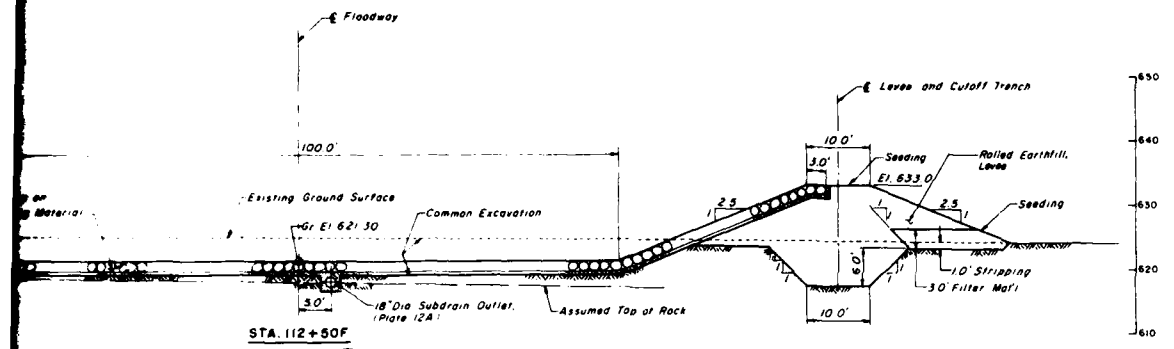
CHUTE-TRANSITION PLAN AND PROFILES

GANNETT FLEMING CORDDRY AND CARPENTER, INC
CONSULTING ENGINEERS
HARRISBURG, PA.

DRAWING N

SCALE AS SHOWN | DATE MARCH 1979 | SHEET

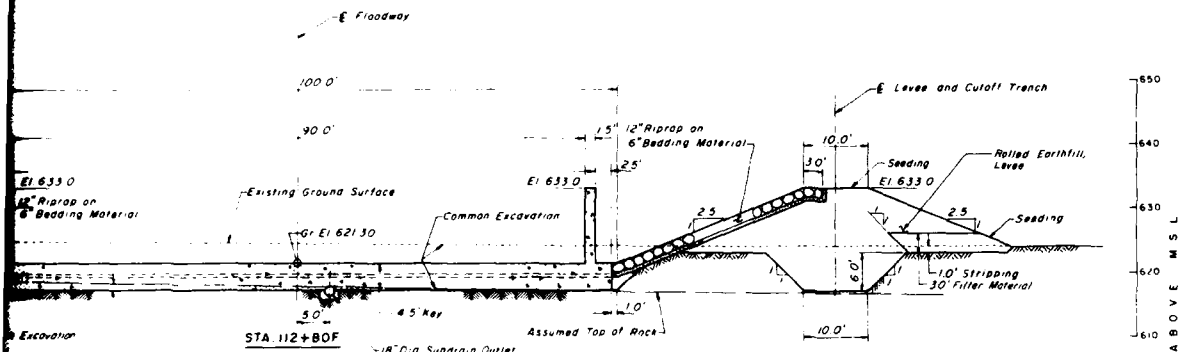

℄ Relocated B & O RR
℄ Existing B & O RR
℄ Floodway
Compacted Earthfill
Seeding
3.0'
Slope to Drain, 1/4" Per Ft
El 632.5
2.5
12" Riprap on 6" Bedding Material
Existing Ground Surface
Gr El 621.30
Common Excavation
1.0' Stripping
100.0
5.0'
18" Dia Subdrain Outlet Plate 12A
Assumed Top of Rock
STA 112+50F
SECTION A
SCALE 1IN = 10FT
90.0
El 633.0
Compacted Backfill
Hack Excavation
4.5 Key
STA 112+80F
SECTION B
SCALE 1IN = 10FT
ELEVATION IN FEET ABOVE MSL
Seeding
Compacted Backfill
Slope to Drain 1/4" Per Ft
10.0'
Existing Ground Surface
Gr El Varies
See Detail "A" Plate 12A
28.0'
29.0'
30'
Rolled Earthfill
STA 113+50F
SECTION C
SCALE 1IN = 10FT
6" Dia Perforated Subdrain Pipe, Typ See Detail "C" Plate 12A
℄ Floodway and John Yago Blvd
Median
Curb
STA 114+80F
SECTION D
SCALE 1IN = 10FT



STA. 112+50F

SECTION A

SCALE 1IN = 10FT



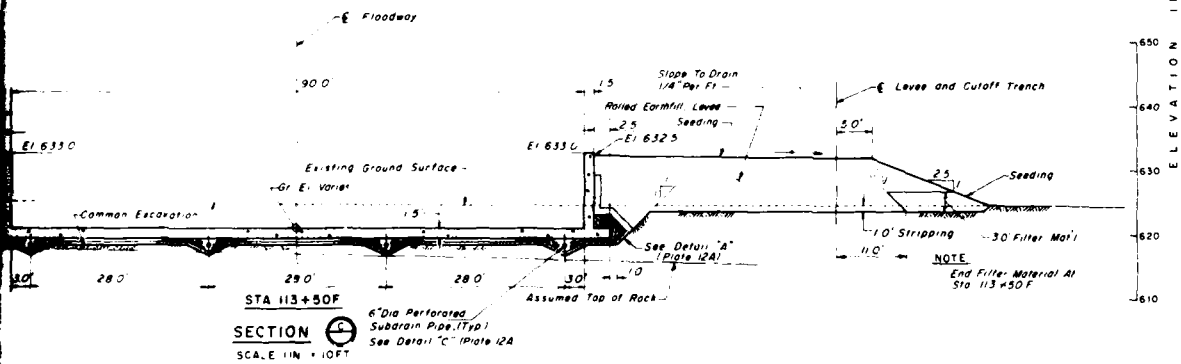
STA. 112+80F

SECTION B

SCALE 1IN = 10FT

NOTE

Transition Cutoff Trench from 6.0' deep at Sta 113+00F to 0.0' deep at Sta 113+50F



STA 113+50F

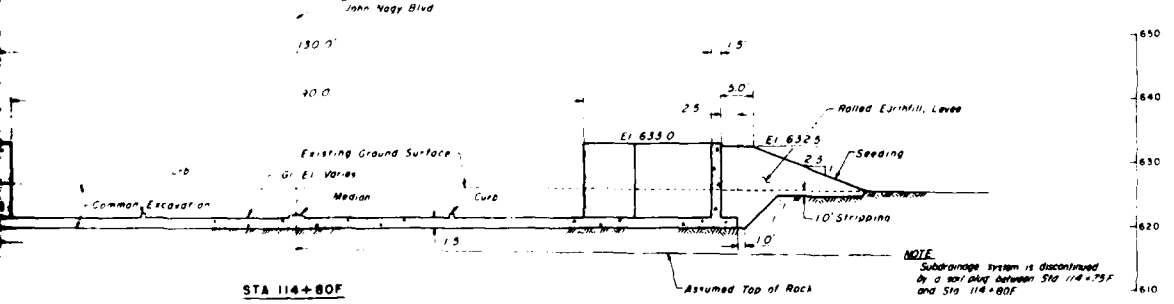
SECTION C

SCALE 1IN = 10FT

NOTE

End Filter Material At Sta 113+50F

6" Dia Perforated Subdrain Pipe (Typ.) See Detail "C" (Plate 12A



STA 114+80F

SECTION D

SCALE 1IN = 10FT

NOTE

Subdrainage system is discontinued by a soil plug between Sta 114+75F and Sta 114+80F

Assumed Top of Rock

ELEVATION IN FEET ABOVE MSL

GENERAL NOTES

1. Sections are cut looking downstream
2. Sections are cut on Plate 10

TO ACCOMPANY PHASE II GDM

REV	DATE	DESCRIPTION

U.S ARMY ENGINEER DISTRICT, BUFFALO
CORPS OF ENGINEERS
BUFFALO, NEW YORK 14207

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

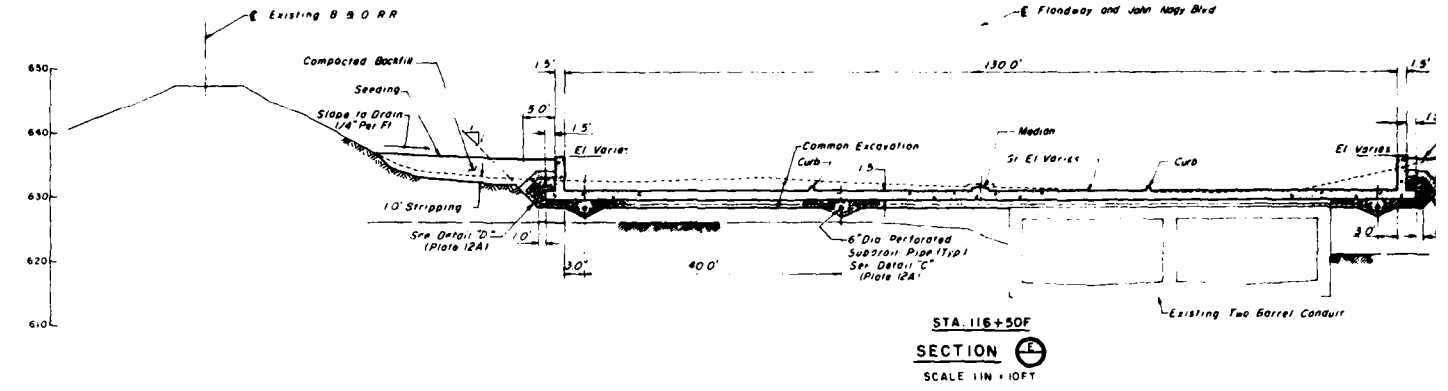
CHUTE-TRANSITION SECTIONS-SHEET 1 OF 2

GANNETT FLEMING CORDDRY AND CARPENTER, INC
CONSULTING ENGINEERS

DRAWING NUMBER

SCALE AS SHOWN | DATE MARCH 1979 | SHEET

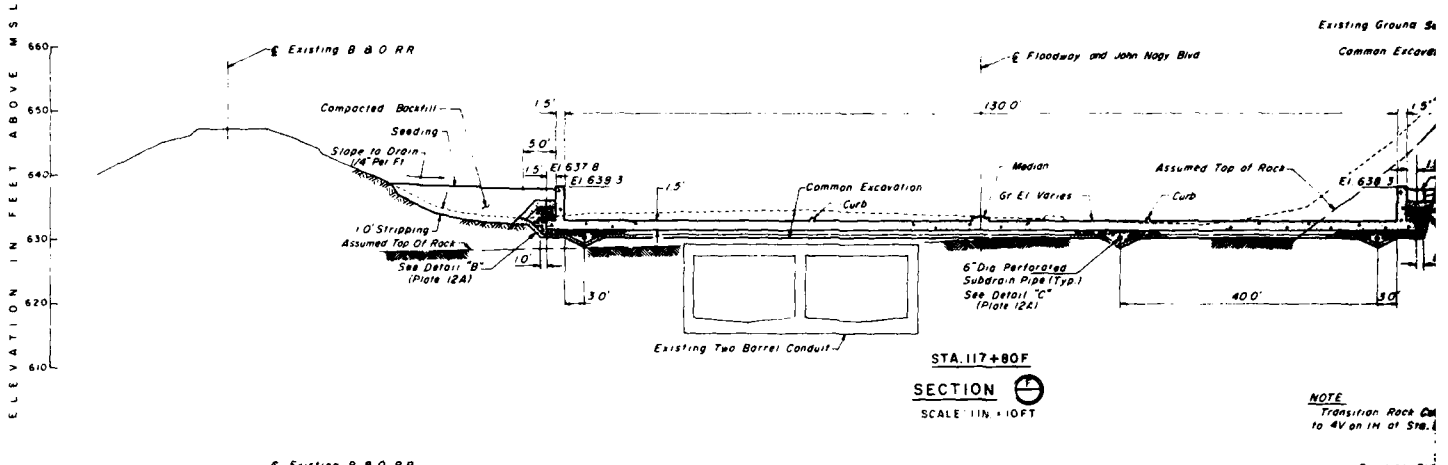
PLATE



STA. 116+50F

SECTION ℄

SCALE 1 IN = 10 FT



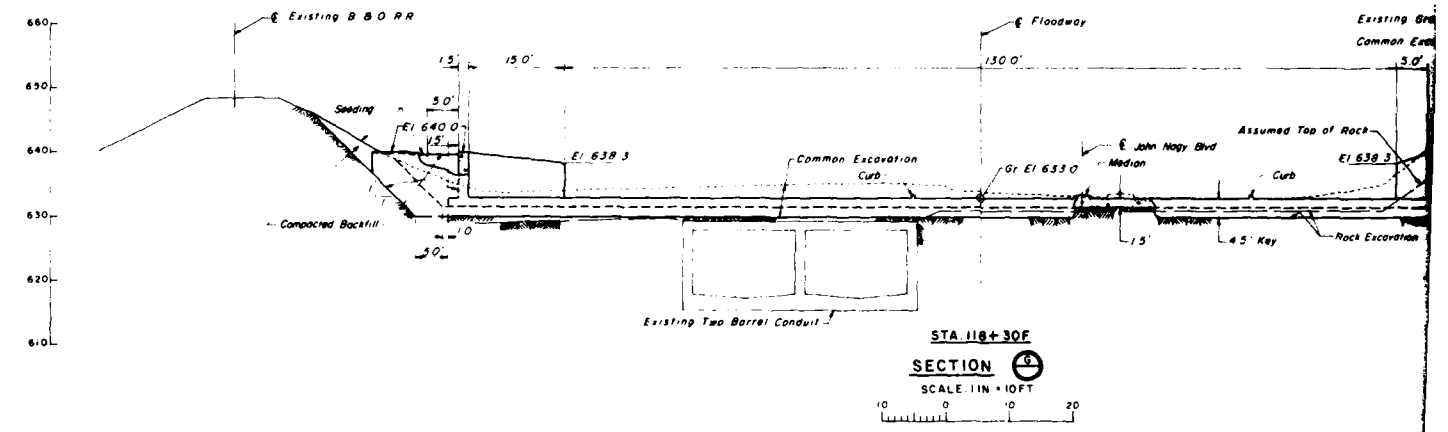
STA. 117+80F

SECTION ℄

SCALE 1 IN = 10 FT

NOTE

Transition Rock Cu
to 4V on 1H at Sta.

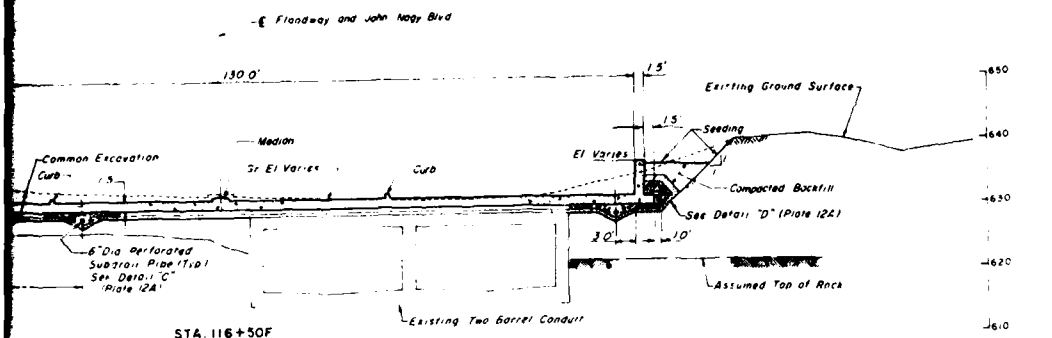


STA. 118+30F

SECTION ℄

SCALE 1 IN = 10 FT

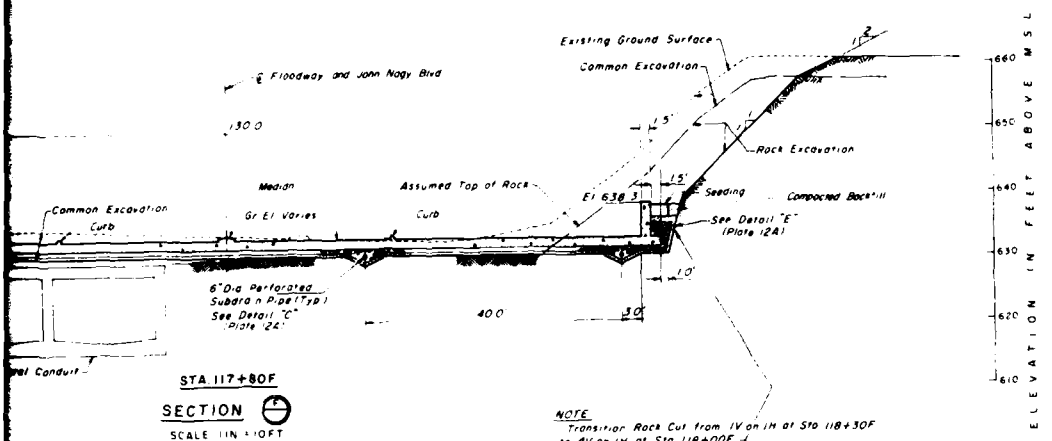
10 0 10 20



STA 116+50F

SECTION

SCALE 1IN = 10FT

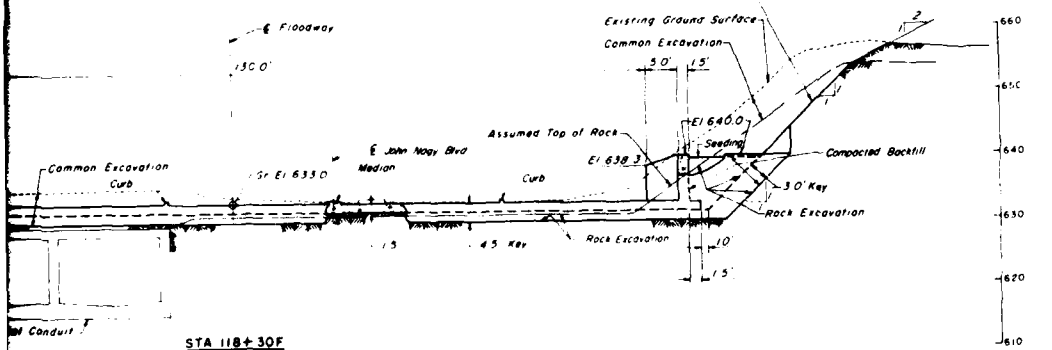


STA 117+80F

SECTION

SCALE 1IN = 10FT

NOTE
Transition Rock Cut from 1V on 1H at Sta 118+30F to 4V on 1H at Sta 118+00F



STA 118+30F

SECTION

SCALE 1IN = 10FT

1 See Notes on Plate 11

TO ACCOMPANY PHASE II GDM

REV	DATE	DESCRIPTION

U.S. ARMY ENGINEER DISTRICT, BUFFALO
CORPS OF ENGINEERS
BUFFALO, NEW YORK 14207

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

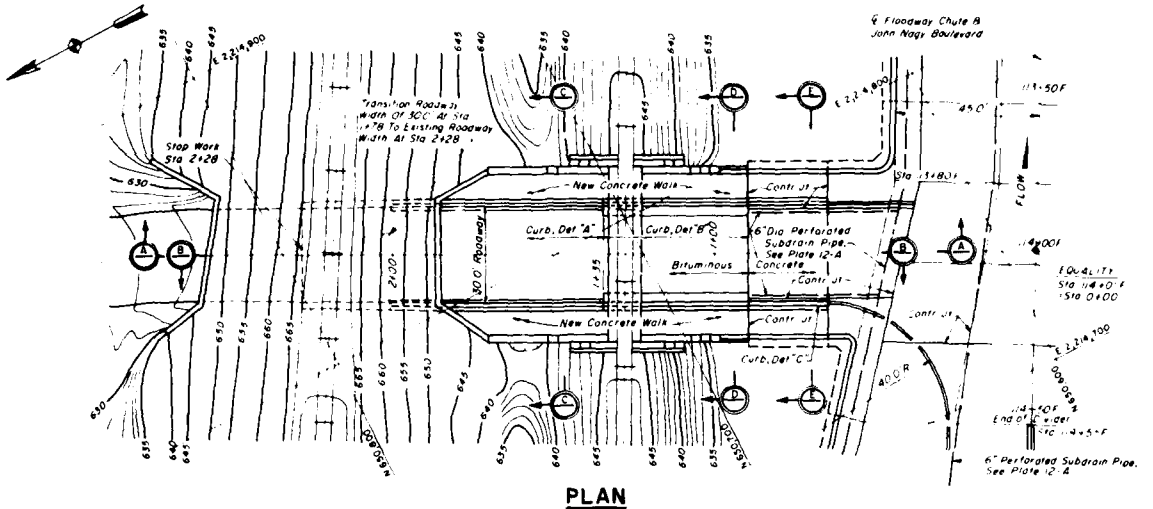
CHUTE-TRANSITION SECTIONS-SHEET 2 OF 2

GANNETT FLEMING CORDDRY AND CARPENTER, INC
CONSULTING ENGINEERS
HARRISBURG, PA

DRAWING NUMBER

SCALE AS SHOWN | DATE MARCH 1979 | SHEET

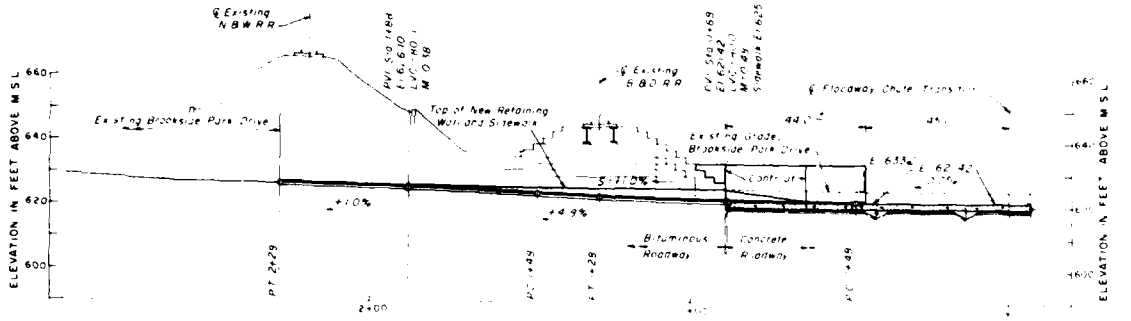
PLATE



PLAN

SCALE 1 IN = 20 FT

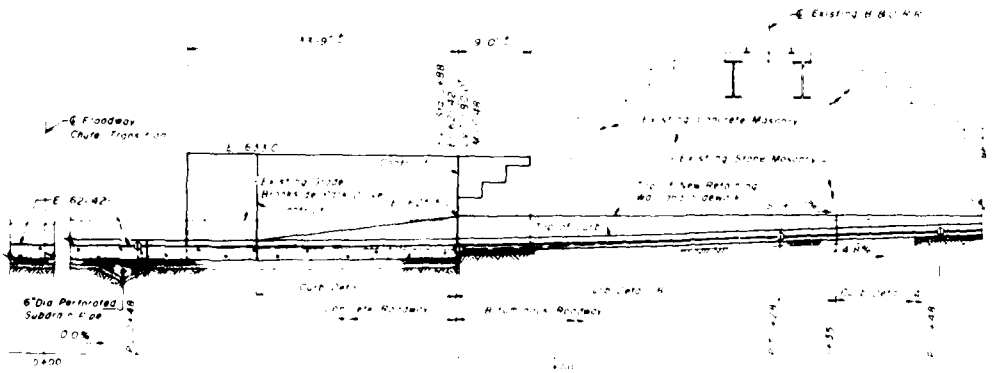
20' 10' 0 20' 40'



SECTION (A)

PROFILE ALONG ℄ BROOKSIDE PARK DRIVE

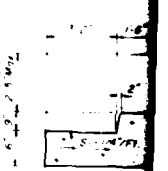
SCALE 1 IN = 20 FT



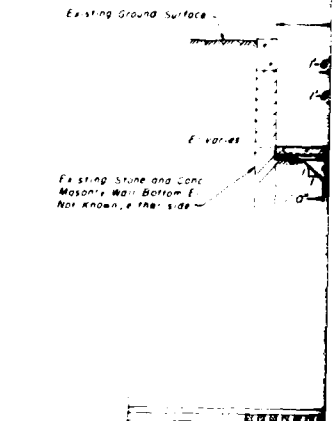
SECTION (B)

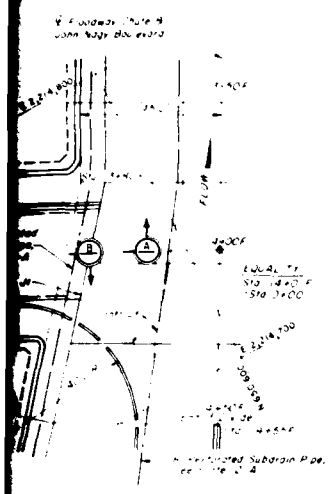
SCALE 1 IN = 5 FT

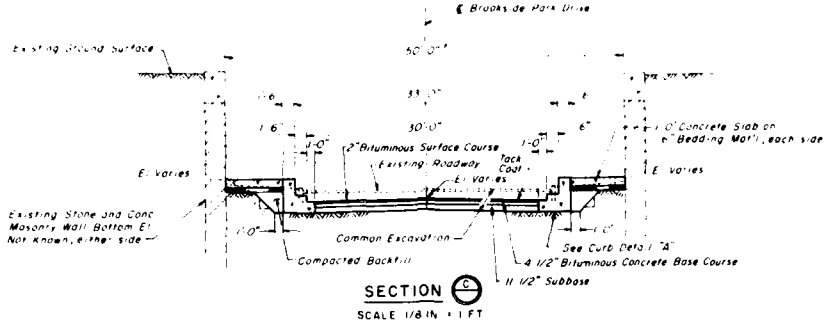
DETAIL "A"



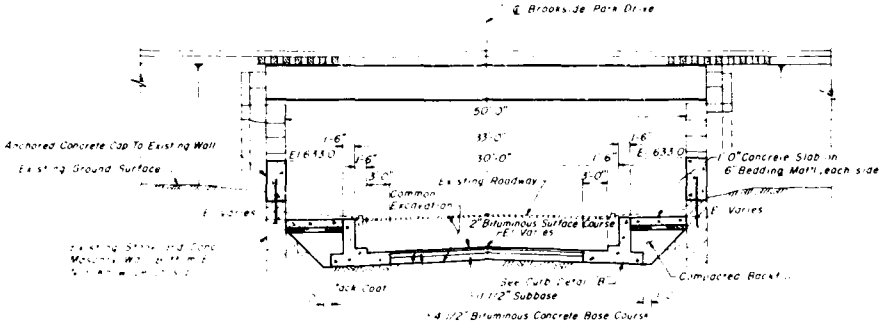
DETAIL



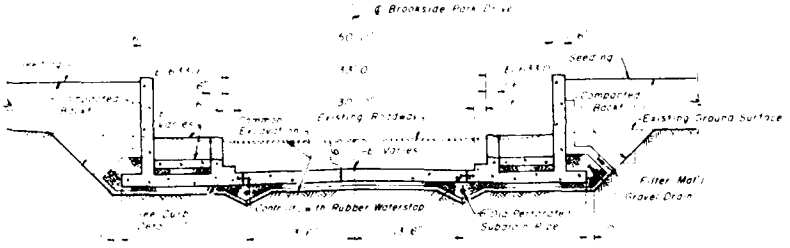




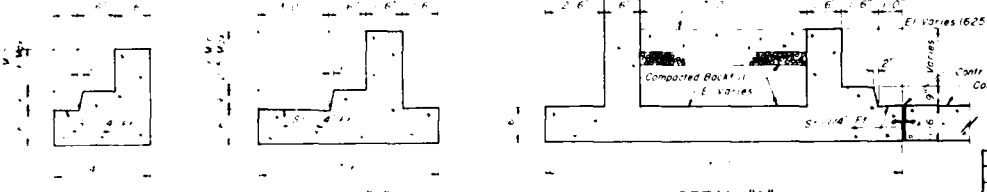
SECTION C
SCALE 1/8 IN = 1 FT



SECTION D
SCALE 1/8 IN = 1 FT



SECTION E
SCALE 1/8 IN = 1 FT



DETAIL "A"

DETAIL "B"

DETAIL "C"

CURB DETAILS

SCALE 1 IN = 2

GENERAL NOTES

1. For Chute - Transition Plan and Profile, see Plate 10
2. Subdrain System and Details presented on Plate 12-A

TO ACCOMPANY PHASE II GDM

REV.	DATE	DESCRIPTION	BY

U.S ARMY ENGINEER DISTRICT, BUFFALO
CORPS OF ENGINEERS
BUFFALO NEW YORK 14207

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

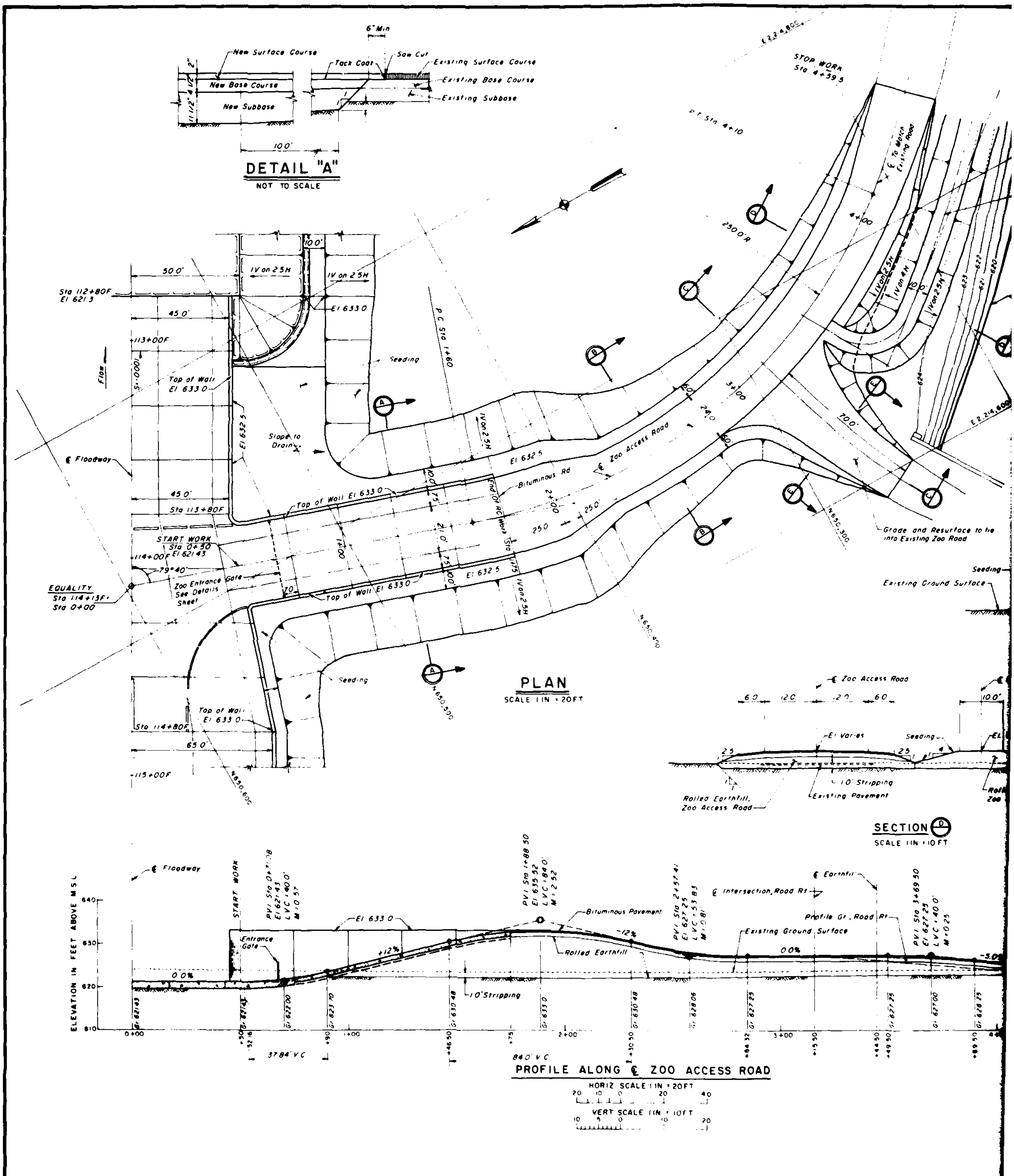
ACCESS TO BROOKSIDE PARK DRIVE
PLAN, PROFILE AND SECTIONS

GANNETT FLEMING CORDDRY AND CARPENTER, INC
CONSULTING ENGINEERS
HARRISBURG PA

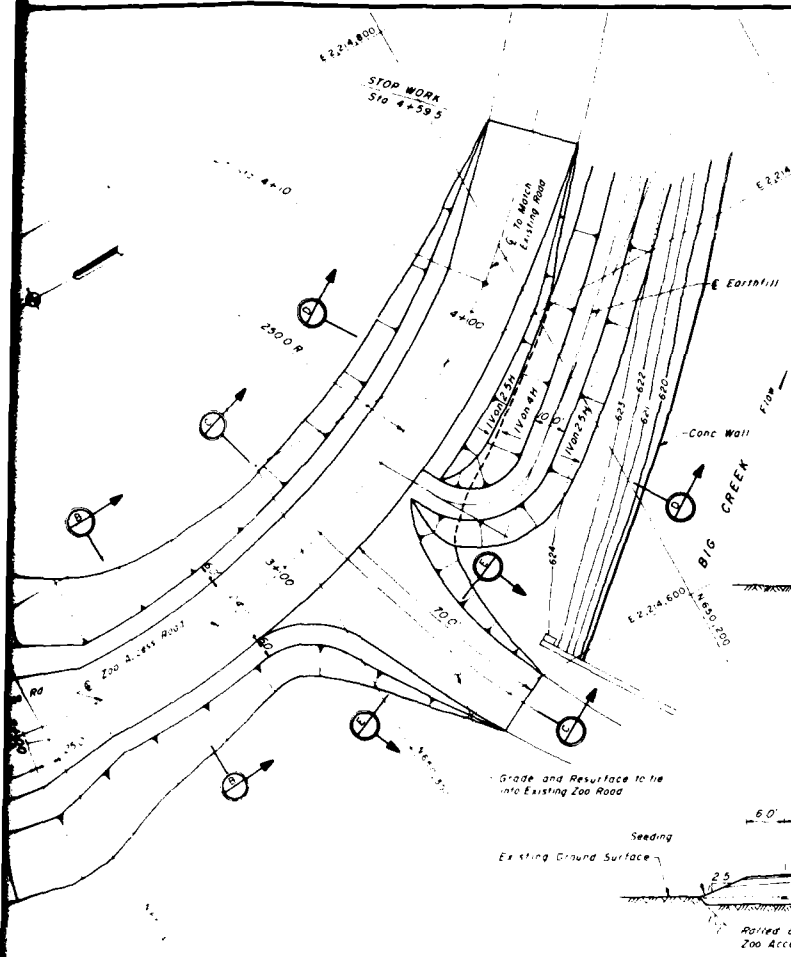
DRAWING NUMBER

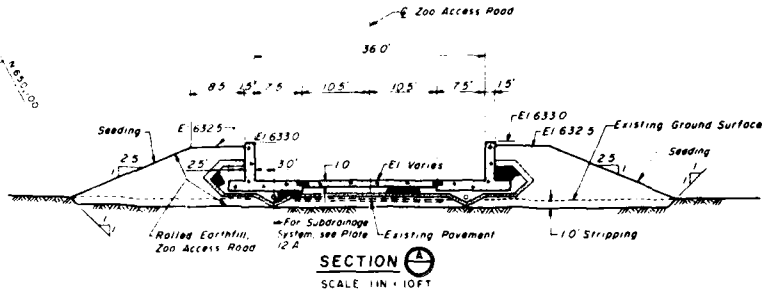
SCALE AS SHOWN | DATE MARCH 1979 | SHEET

PLATE 13

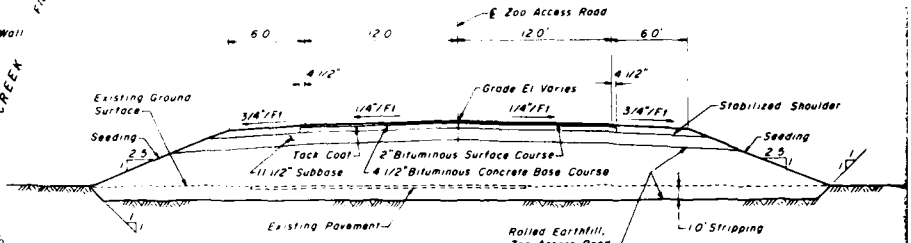


DETAIL "A"
NOT TO SCALE
New Surface Course
New Base Course
New Subbase
Tack Coat
Saw Cut
Existing Surface Course
Existing Base Course
Existing Subbase
6" Min
STOP WORK
Sta 4+59.5
PLAN
SCALE 1 IN = 20 FT
¢ Floodway
¢ Zoo Access Road
Bituminous Rd
Top of Wall El 633.0
START WORK
Sta 0+50
El 621.43
EQUALITY
Sta 114+13F
Sta 0+00
Zoo Entrance Gate
See Details Sheet
Seeding
Slope to Drain
Grade and Resurface to tie into Existing Zoo Road
Existing Ground Surface
SECTION D
SCALE 1 IN = 10 FT
Rolled Earthfill, Zoo Access Road
Existing Pavement
1.0' Stripping
PROFILE ALONG ¢ ZOO ACCESS ROAD
HORIZ SCALE 1 IN = 20 FT
VERT SCALE 1 IN = 10 FT
ELEVATION IN FEET ABOVE M.S.L.
Entrance Gate
Bituminous Pavement
Rolled Earthfill
Existing Ground Surface
Profile Gr., Road Rt
¢ Intersection, Road Rt
¢ Earthfill

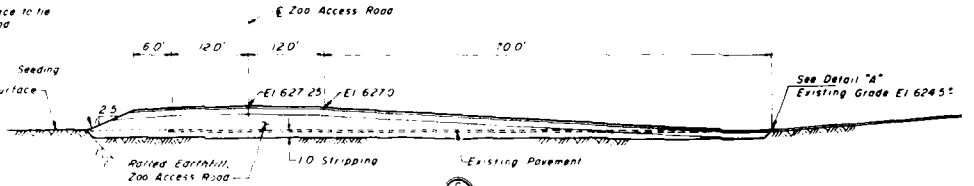




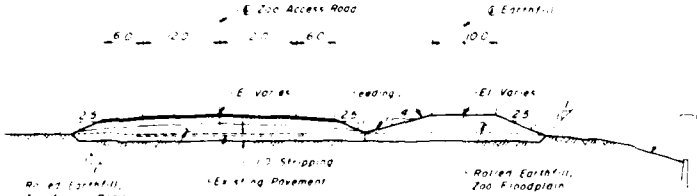
SECTION A
SCALE 1 IN = 10 FT



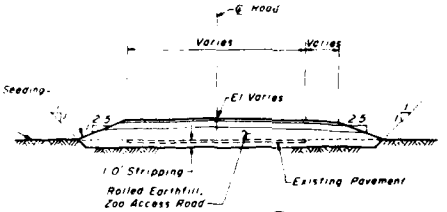
SECTION B
SCALE 1 IN = 5 FT



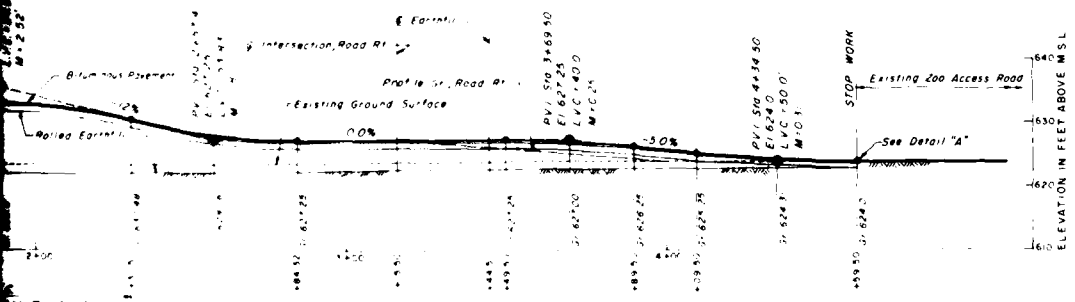
SECTION C
SCALE 1 IN = 10 FT



SECTION D
SCALE 1 IN = 10 FT



SECTION E
SCALE 1 IN = 10 FT



FILE ALONG ℄ ZOO ACCESS ROAD

HOR Z SCALE 1 IN = 40 FT

VERT SCALE 1 IN = 4 FT

GENERAL NOTES

1. For Plan and Profile of Zoo Floodplain, See Plate 7
2. For Subdrainage System, See Plate 12 A

TO ACCOMPANY PHASE II GDM

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U.S. ARMY ENGINEER DISTRICT, BUFFALO
CORPS OF ENGINEERS
BUFFALO, NEW YORK 14207

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

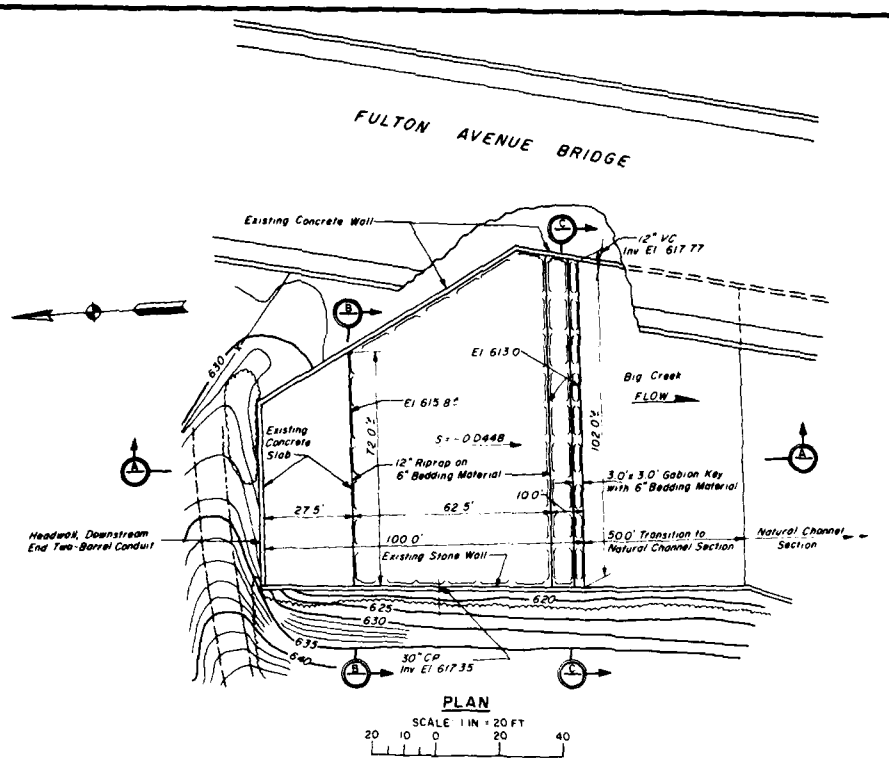
ZOO ACCESS ROAD
PLAN, PROFILE AND SECTIONS

GANNETT FLEMING CORDDRY AND CARPENTER, INC
CONSULTING ENGINEERS
HARRISBURG, PA

DRAWING NUMBER

SCALE AS SHOWN | DATE MARCH 1979 | SHEET

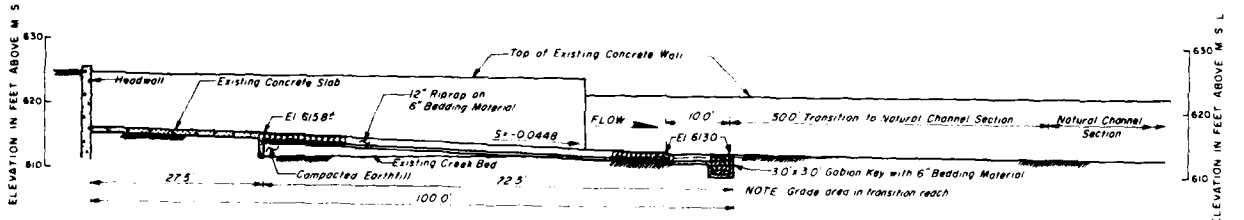
PLATE



PLAN

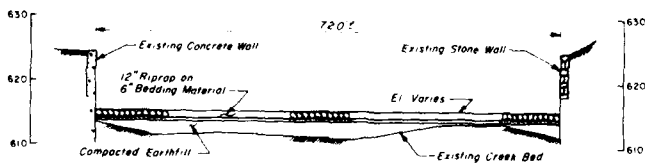
SCALE 1 IN = 20 FT

20 10 0 20 40



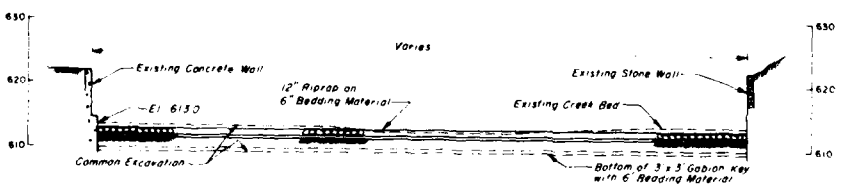
SECTION (A)

SCALE 1 IN = 10 FT



SECTION (B)

SCALE 1 IN = 10 FT

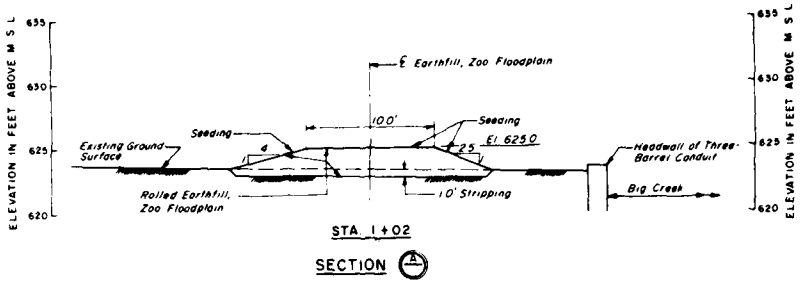


SECTION (C)

SCALE 1 IN = 10 FT

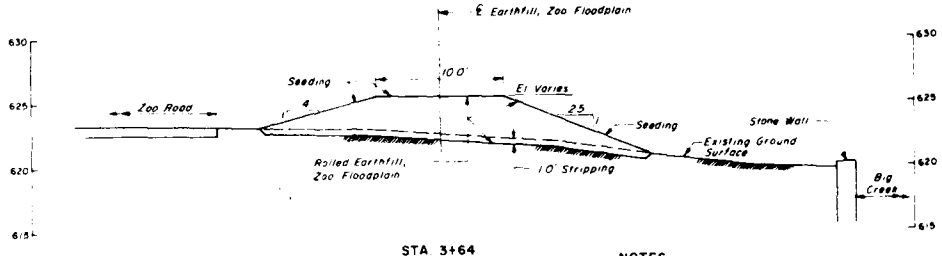
10 5 0 10 20

RIPRAPPED TRANSITION



STA 1+02

SECTION A



STA 3+64

SECTION B

NOTES

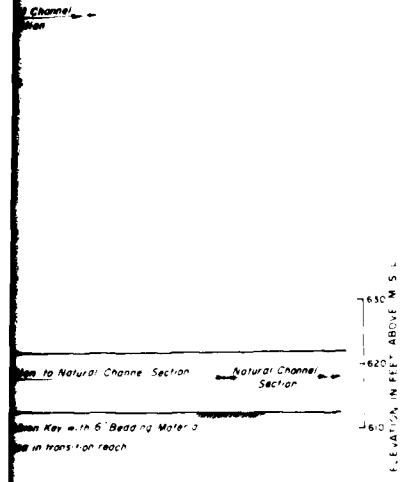
1. For Plan and Profile of Earthfill at Zoo Floodplain, see Plate 7
2. Sections cut on Plan on Plate 7

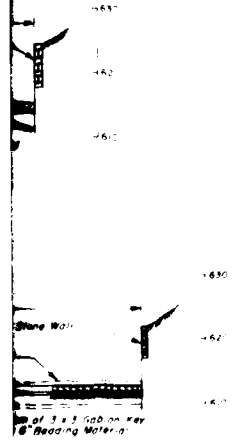
TYPICAL SECTIONS

EARTHFILL AT ZOO FLOODPLAIN

SCALE 1 IN = 5 FT

5 0 5 10





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REV	DATE	DESCRIPTION	BY

U.S. ARMY ENGINEER DISTRICT, BUFFALO
CORPS OF ENGINEERS
BUFFALO, NEW YORK 14207

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

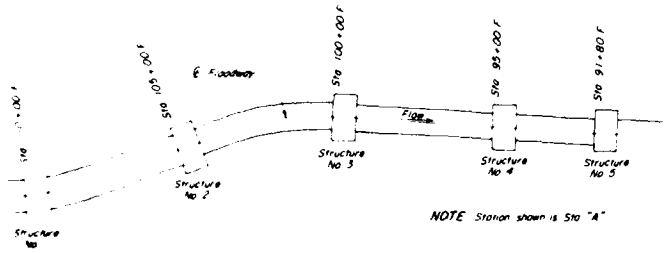
RIPRAPPED TRANSITION AND TYPICAL SECTIONS EARTHFILL AT ZOO FLOODPLAIN

GANNETT FLEMING CORDRY AND CARPENTER, INC
CONSULTING ENGINEERS
HARRISBURG, PA

DRAWING NUMBER

SCALE AS SHOWN | DATE MARCH 1979 | SHEET

PLATE 15

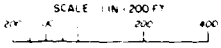


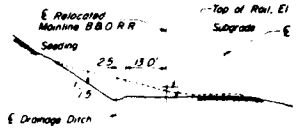
NOTE Station shown is Sta "A"

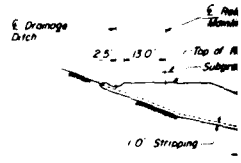
PLAN

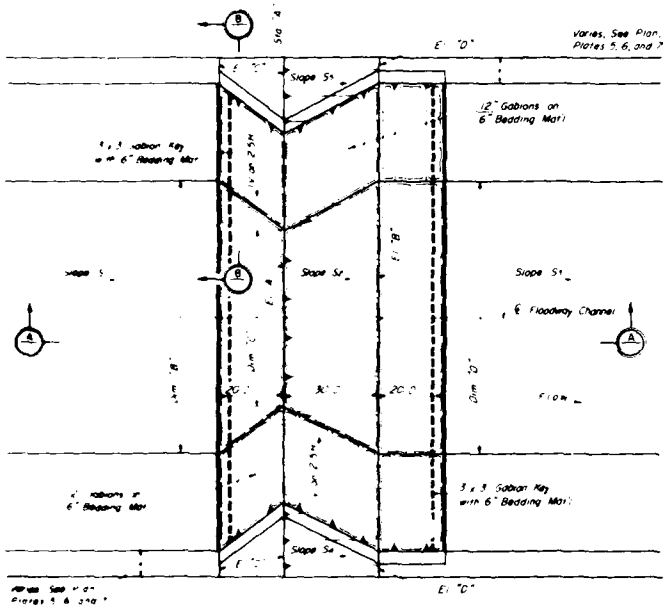
LOCATION OF DROP STRUCTURES

SCALE 1 IN = 200 FT



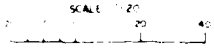


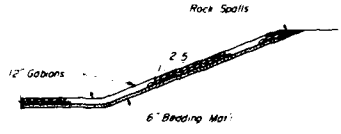




PLAN

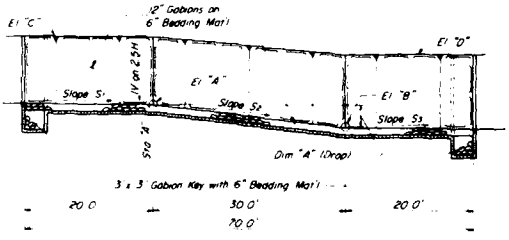
SCALE 1" = 20'





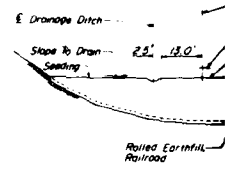
SECTION (B)

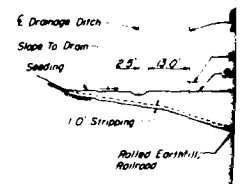
SCALE 1" = 10'

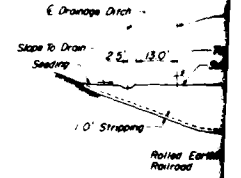


SECTION (A)

SCALE 1" = 10'





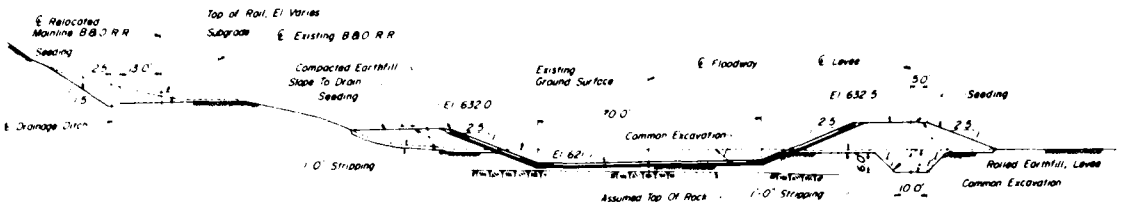


DROP STRUCTURES

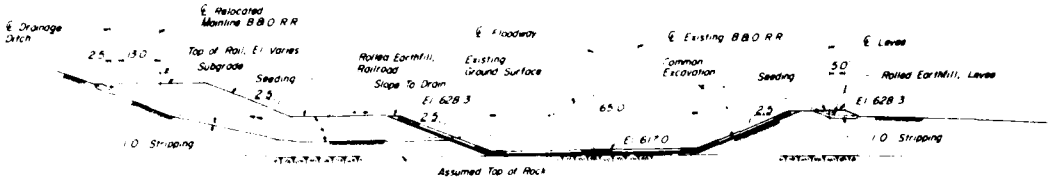
TABLE FOR DIMENSIONS, ELEVATIONS, AND SLOPES OF DROP STRUCTURES

DROP STRUCTURE NUMBER	STA "A"	DIM "A" (DROP)	DIM "B"	DIM "C"	DIM "D"	EL "A"	EL "B"	EL "C"		EL "D"		SLOPE S_1	SLOPE S_2	SLOPE S_3	SLOPE S_4	SLOPE S_5
								RT BANK	LT BANK	RT BANK	LT BANK					
	0+00 F	N A	90.0	70.0	100.0	621.1	617.6	632.5	632.0	629.1	628.6	-0.00071	-0.116667	-0.00128	-0.11333	-0.11333
2	0+00 F		85.0	65.0	85.0	617.0	614.0	628.8	628.3	625.8	625.8	-0.00128	-0.10000	-0.00106	-0.10000	-0.08333
3	0+00 F		85	55.0	85.0	613.5	610.5	625.5	625.5	622.3	622.3	-0.00106	-0.10000	-0.00106	-0.10666	-0.10666
4	0+00 F		85	55.0	85.0	610.0	607.0	622.0	622.0	618.8	618.8	-0.00106	-0.10000	-0.00690	-0.10666	-0.10666
5	0+00 F		85	55	85	605.0	603	610.01	618.5	608.01	615.9	-0.00590	-0.06333	-0.00273	-0.06666	-0.08666

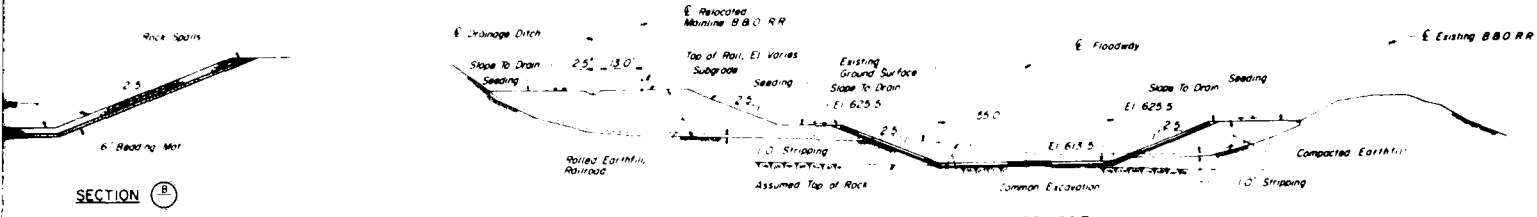
NOTE All Dimensions in Feet



STA 110+00F
DROP STRUCTURE NO. 1

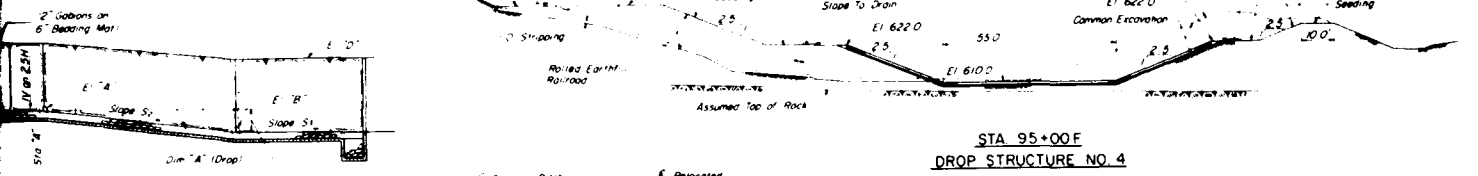


STA 105+00F
DROP STRUCTURE NO. 2



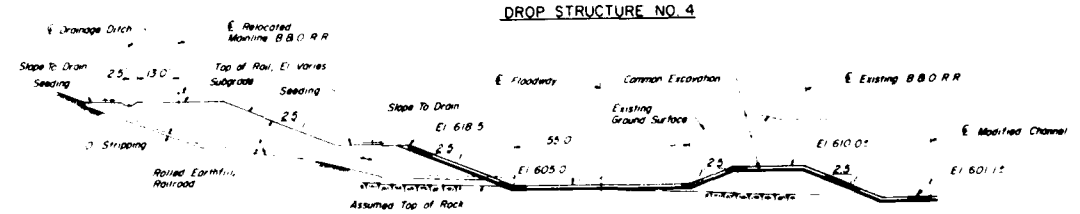
SECTION (B)
SCALE 1" = 10'

STA 100+00F
DROP STRUCTURE NO. 3



SECTION (A)
SCALE 1" = 10'

STA 95+00F
DROP STRUCTURE NO. 4



STA 91+80F
DROP STRUCTURE NO. 5

SECTIONS
SCALE 1 IN = 20 FT

NOTES

1. Sections cut at Sta "A", looking downstream
2. For drainage ditch and roadbed details of the relocated mainline B&O R R, See Plate 31

OP STRUCTURES

OPE S	SLOPE S2	SLOPE S1	SLOPE S4	SLOPE S3
0.0007	-0.06667	0.00128	-0.01333	-0.1333
0.00128	-0.10000	-0.00106	0.10000	-0.08333
0.00106	0.10000	0.00106	-0.10666	-0.10666
0.00106	-0.10000	-0.00690	0.10666	-0.10666
0.00690	0.06333	0.00273	-0.06666	-0.08666

TO ACCOMPANY PHASE II GDM

REV	DATE	DESCRIPTION

U.S ARMY ENGINEER DISTRICT, BUFFALO
CORPS OF ENGINEERS
BUFFALO, NEW YORK 14207

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

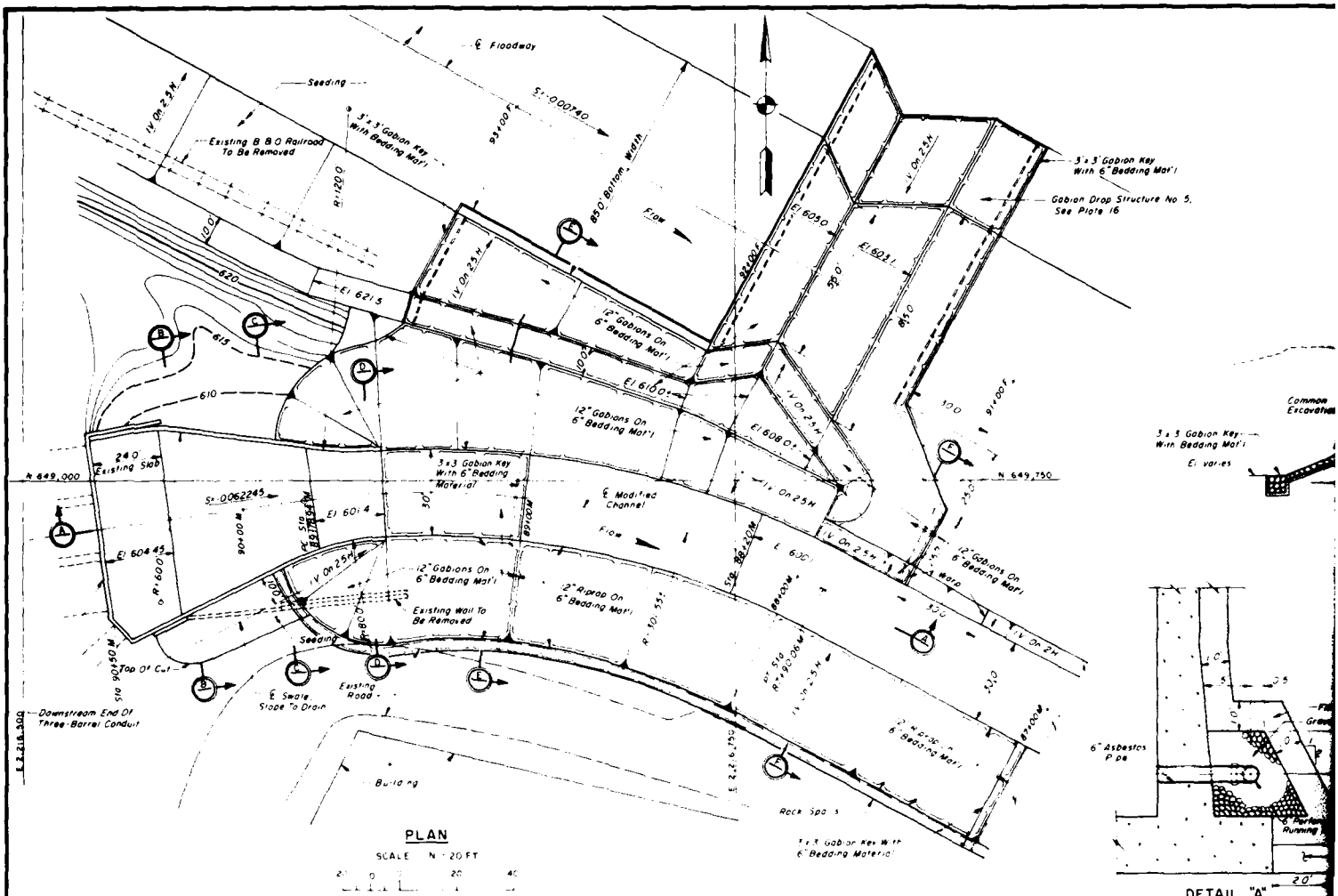
GABION DROP STRUCTURES
PLAN AND SECTIONS

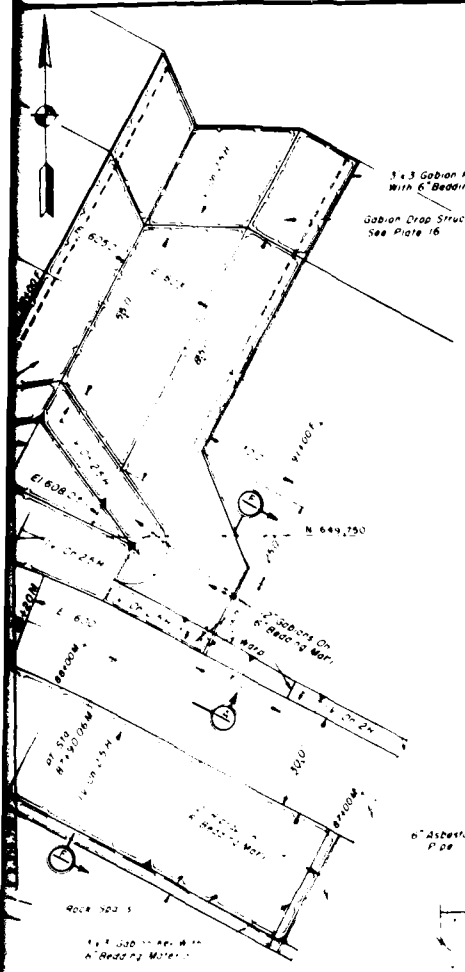
GANNETT FLEMING CORDDRY AND CARPENTER, INC
CONSULTING ENGINEERS

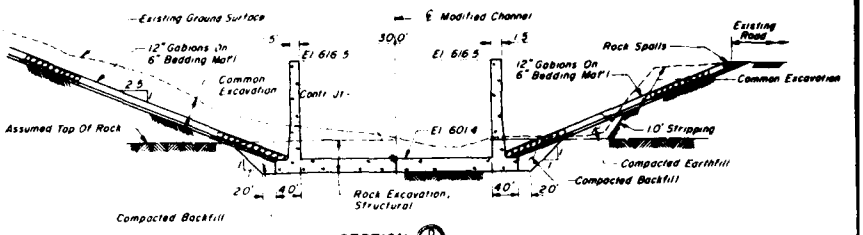
DRAWING NUMBER

SCALE AS SHOWN | DATE MARCH 1979 | SHEET

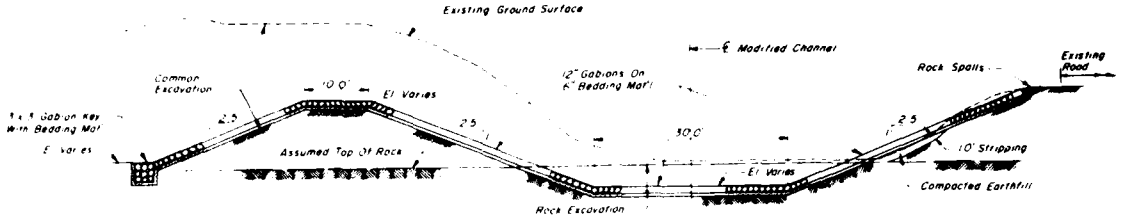
PLATE


℄ Floodway
Seeding
S=0.00740
93.00 Ft.
1V On 2.5H
Existing B & O Railroad To Be Removed
3'x3' Gabion Key With Bedding Mat'l
R=1200
85.0' Bottom Width
Flow
3'x3' Gabion Key With 6" Bedding Mat'l
Gabion Drop Structure No 5, See Plate 16
El 603.0
El 603.1
El 621.5
12" Gabions On 6" Bedding Mat'l
El 610.0±
El 608.0±
N 649,900
N 649,750
24.0' Existing Slab
S=.0062245
El 601.4
℄ Modified Channel
Existing Wall To Be Removed
12" Riprap On 6" Bedding Mat'l
Seeding
Top Of Cut
℄ Swale Slope To Drain
Existing Road
Downstream End Of Three-Barrel Conduit
Building
Rock Spoil
PLAN
SCALE 1" = 20 FT
Common Excavation
3'x3' Gabion Key With Bedding Mat'l
El varies
6" Asbestos Pipe
DETAIL "A"
WALL DRAIN
NOT TO SCALE
Top Of Wall El 616.5
El 604.45
Assumed Top Of Rock
Weep Hole
Rock Excavation
Three-Barrel Conduit
24.0' Existing Slab
76.0' Transition
50.0' - 12" Gabions On 6" Bedding Mat'l
SECTION A
SCALE 1" = 10 FT
Slope To Drain
Seeding
Compacted Backfill Common Excavation Wall Drain, See Detail "A"
Assumed Top Of Rock
Existing Ground Surface
Rock Excavation, Structural
℄ Swale For Drainage
Existing Ground Surface
Common Excavation Existing Wall To Be Removed Compacted Backfill Wall Drain, See Detail "A"
SECTION B
SCALE 1" = 10 FT
Existing Ground Surface
SECTION
SCALE 1" =

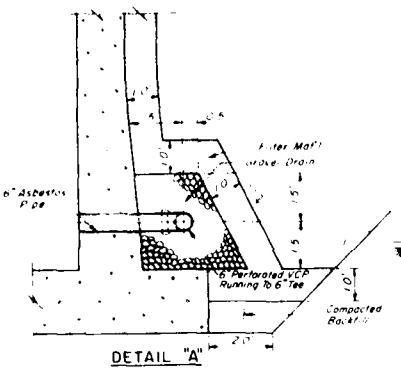




SECTION (B)
SCALE 1 IN = 10 FT



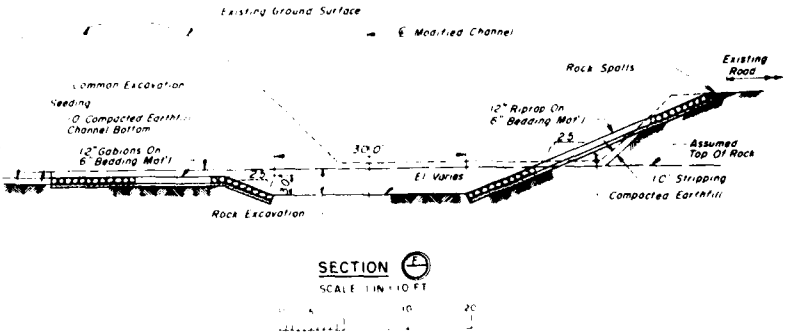
SECTION (E)
SCALE 1 IN = 10 FT



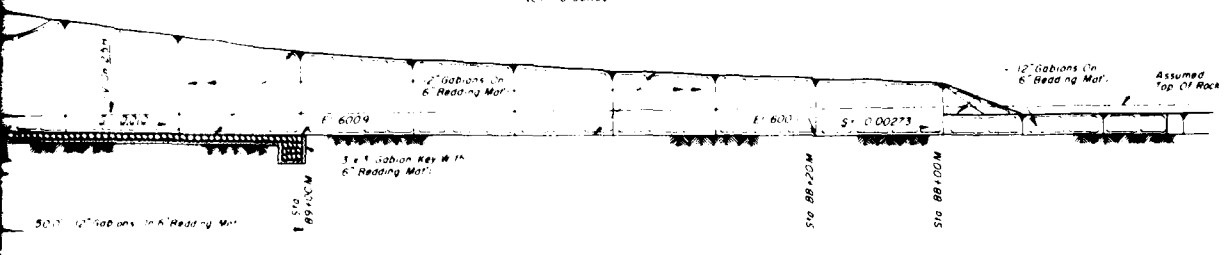
DETAIL "A"

WALL DRAIN

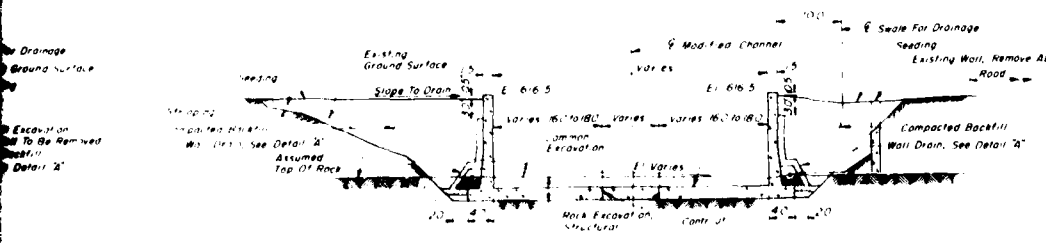
NOT TO SCALE



SECTION (F)
SCALE 1 IN = 10 FT



SECTION (A)



SECTION (C)
SCALE 1 IN = 10 FT

GENERAL NOTES:

1. For Wall Drain, See Plate 19
2. Anchor Bars and Weep Holes will be provided for the slab of the concrete transition. Details will be shown on the Contract Drawings.

TO ACCOMPANY PHASE II GDM

REV	DATE	DESCRIPTION

U.S ARMY ENGINEER DISTRICT, BUFFALO
CORPS OF ENGINEERS
BUFFALO, NEW YORK 14207

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

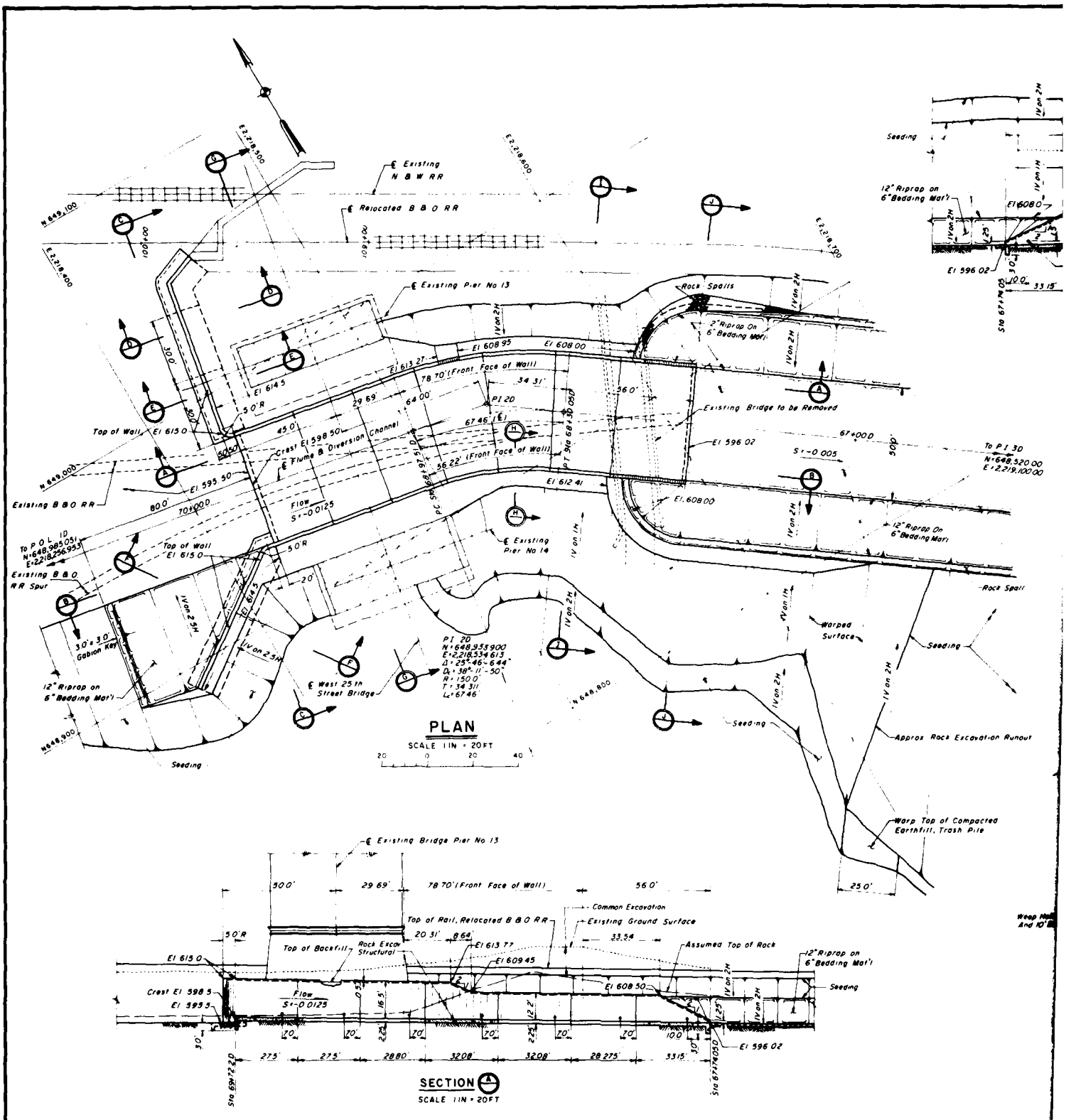
FLOODWAY-MODIFIED CHANNEL CONFLUENCE AREA

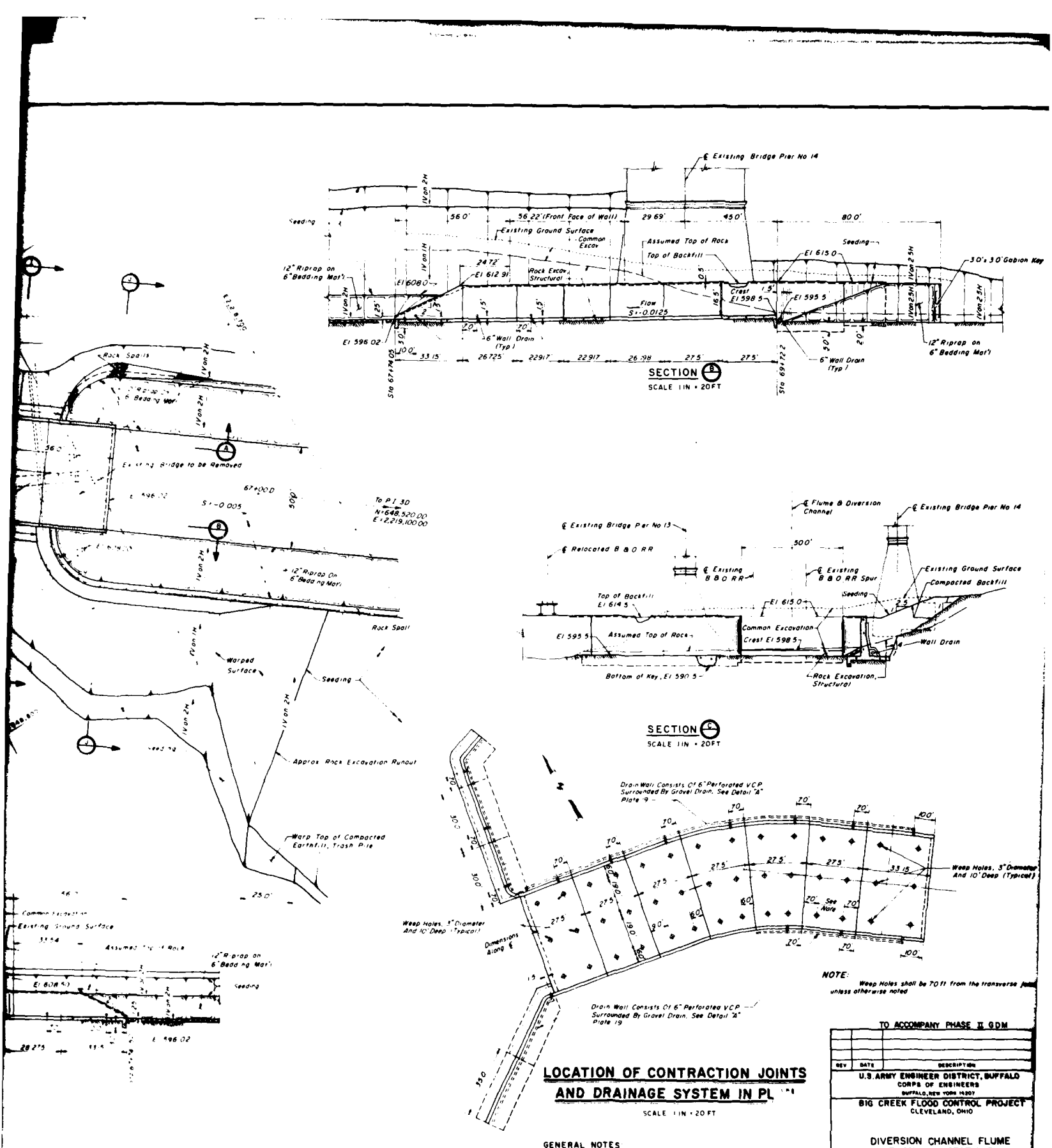
PLAN, SECTIONS AND DETAILS

GANNETT FLEMING CORDDRY AND CARPENTER, INC CONSULTING ENGINEERS HARRISBURG, PA	DRAWING NUMBER
SCALE AS SHOWN	DATE MARCH 1979

SHEET

PLATE


℄ Existing N & W RR
℄ Relocated B & O RR
℄ Existing Pier No 13
℄ Existing Pier No 14
℄ Flume B Diversion Channel
℄ West 25th Street Bridge
Existing B & O RR
Existing B & O RR Spur
Existing Bridge to be Removed
Rock Spalls
2' Riprap On 6" Bedding Mat'l
12" Riprap on 6" Bedding Mat'l
Top of Wall El 615 0
Crest El 598 50
Flow S = 0 0125
Top of Wall El 615 0
30' x 30' Gabion Key
Seeding
Warped Surface
Approx Rock Excavation Runout
Warp Top of Compacted Earthfill, Trash Pile
To P O L ID N 648,985 051 E 2,218,256 933
To P I 30 N 648,320 00 E 2,219,100 00
P I 20 N 648,955 900 E 2,218,534 613 Δ = 25°-46'-644 D = 38°-11'-50 R = 150 0' T = 34 31' L = 67 46'
PLAN
SCALE 1 IN = 20 FT
Common Excavation
Existing Ground Surface
Top of Rail, Relocated B & O RR
Top of Backfill
Rock Excav Structural
Assumed Top of Rock
Crest El 598 5
El 599 5
El 613 0
El 613 77
El 609 45
El 608 50
El 596 02
Sta 69+22 0
Sta 87+40 50
SECTION A
SCALE 1 IN = 20 FT



LOCATION OF CONTRACTION JOINTS AND DRAINAGE SYSTEM IN PL

SCALE 1 IN = 20 FT

NOTE: Weep Holes shall be 70 ft from the transverse joint unless otherwise noted

GENERAL NOTES

1. For Sections, See Plate 19
2. For Plan And Profile Of Diversion Channel And Modified Channel, See Plate 4

TO ACCOMPANY PHASE II GDM

REV	DATE	DESCRIPTION

U.S. ARMY ENGINEER DISTRICT, BUFFALO
CORPS OF ENGINEERS
BUFFALO, NEW YORK 14207

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

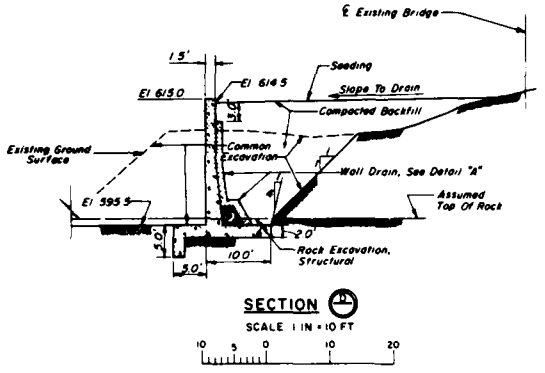
DIVERSION CHANNEL FLUME
PLAN AND SECTIONS

GANNETT FLEMING CORDDRY AND CARPENTER, INC
CONSULTING ENGINEERS
HARRISBURG, PA

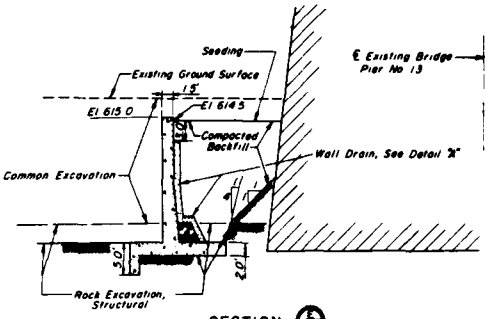
DRAWING NUMBER

SCALE AS SHOWN | DATE MARCH 1979 | SHEET

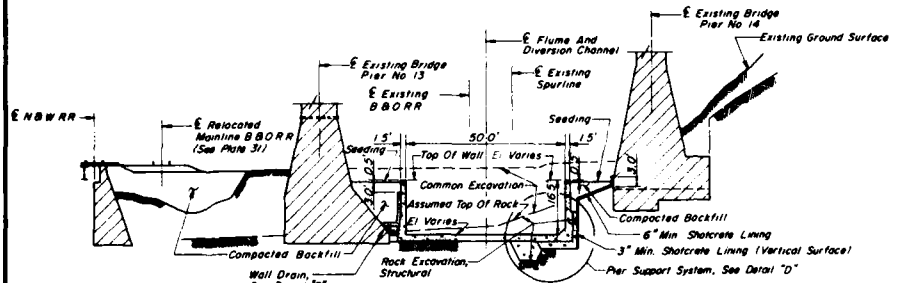
PLATE



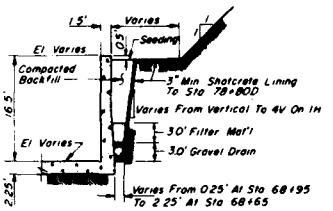
SECTION (B)
SCALE 1 IN = 10 FT



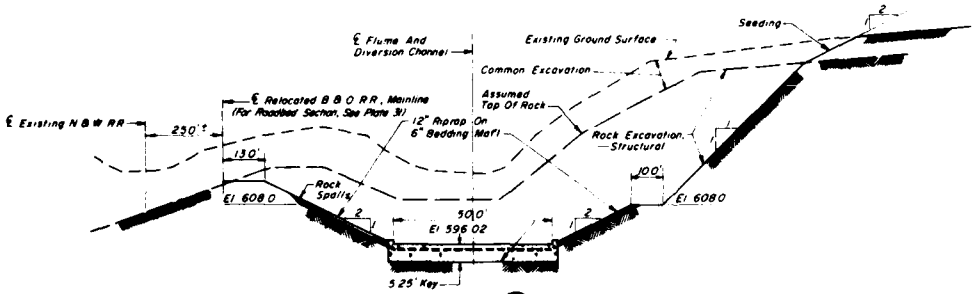
SECTION (A)
SCALE 1 IN = 10 FT



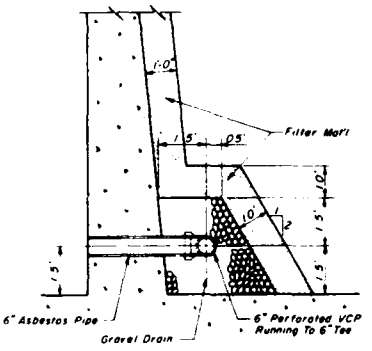
SECTION (G)
SCALE 1 IN = 20 FT
20 10 0 20 40



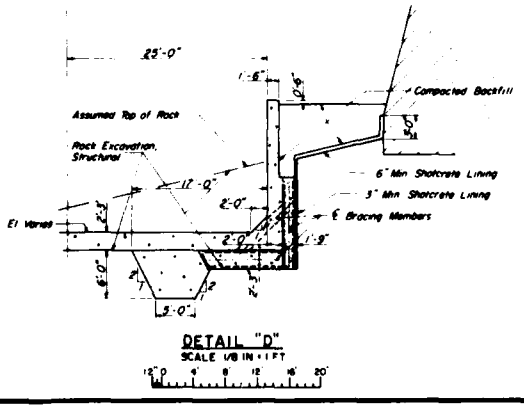
SECTION (H)
SCALE 1 IN = 10 FT



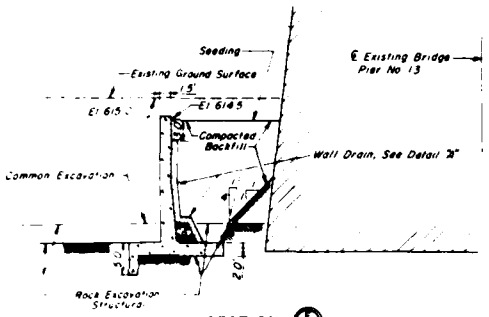
SECTION (E)
SCALE 1 IN = 20 FT



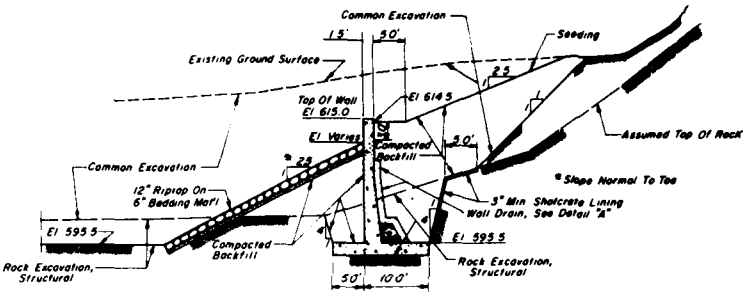
DETAIL "A"



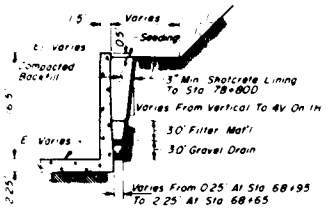
DETAIL "D"
SCALE 1/8 IN = 1 FT
12" 0 4' 8' 12' 16' 20'



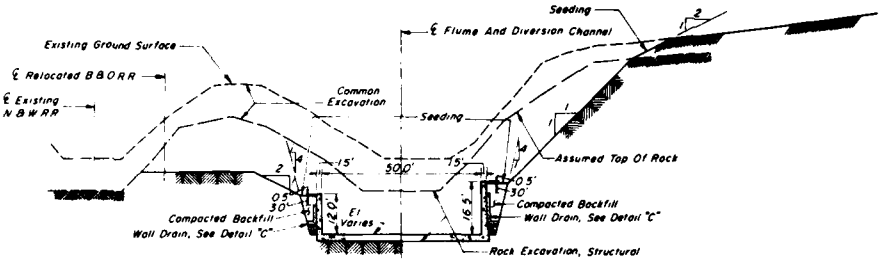
SECTION
SCALE 1 IN = 10 FT



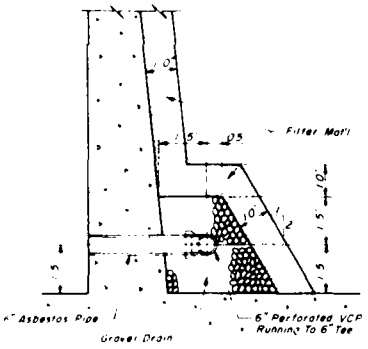
SECTION
SCALE 1 IN = 10 FT



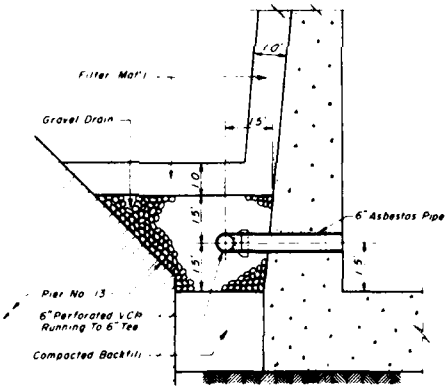
SECTION
SCALE 1 IN = 10 FT



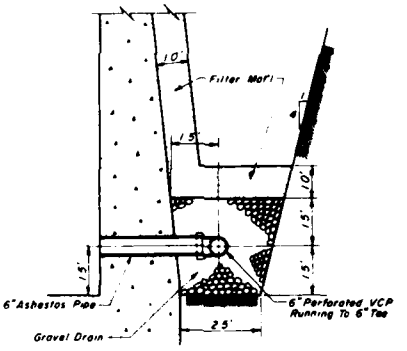
SECTION
SCALE 1 IN = 20 FT



DETAIL "A"



DETAIL "B"



DETAIL "C"

WALL DRAIN DETAILS

NOT TO SCALE

GENERAL NOTES:

1. Sections Cut On Plate 18

TO ACCOMPANY PHASE II GDM

REV	DATE	DESCRIPTION

U.S. ARMY ENGINEER DISTRICT, BUFFALO
CORPS OF ENGINEERS
BUFFALO, NEW YORK 14207

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

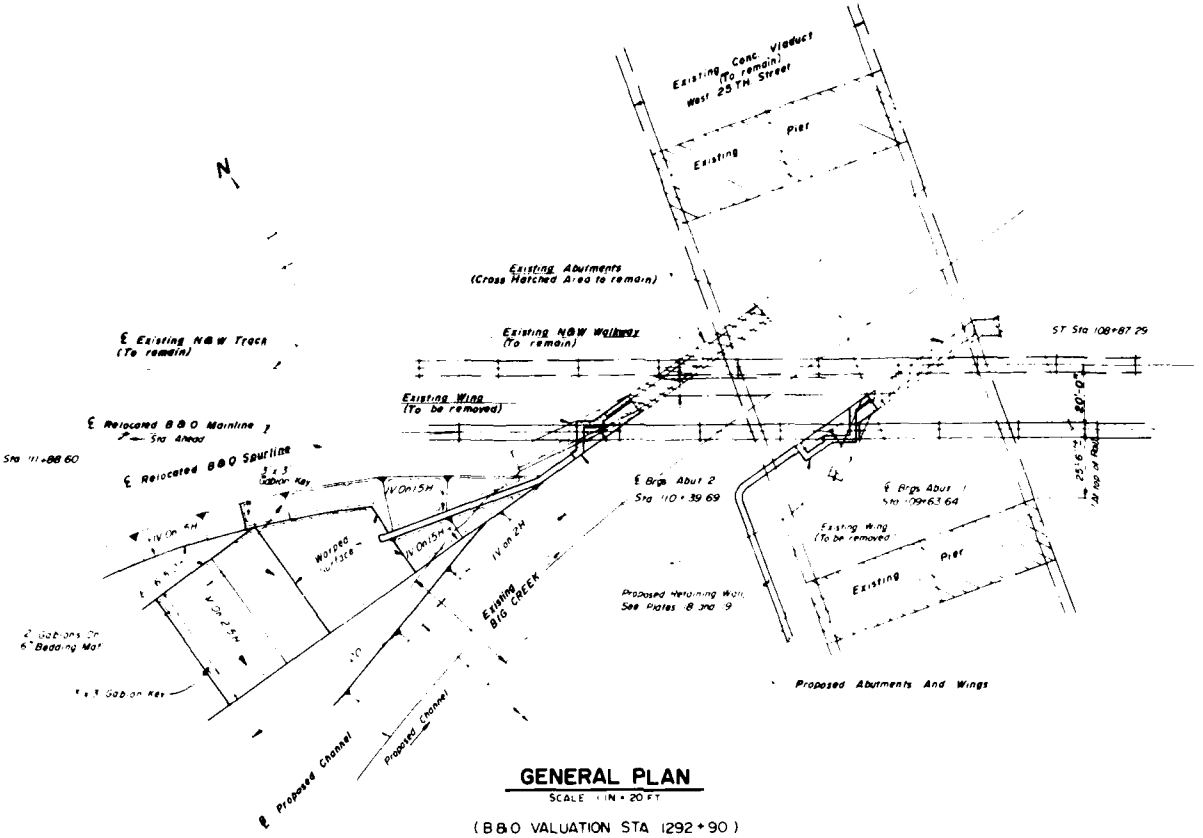
DIVERSION CHANNEL FLUME
SECTIONS AND DETAILS

GANNETT FLEMING CORDDRY AND CARPENTER, INC
CONSULTING ENGINEERS
HARRISBURG, PA

DRAWING NUMBER

SCALE AS SHOWN | DATE MARCH 1979 | SHEET

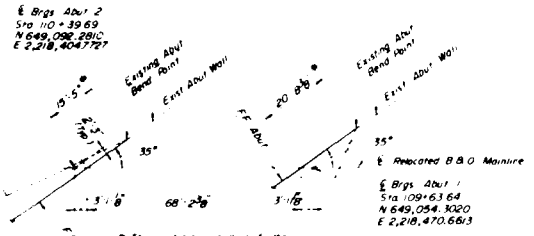
PLATE



GENERAL PLAN

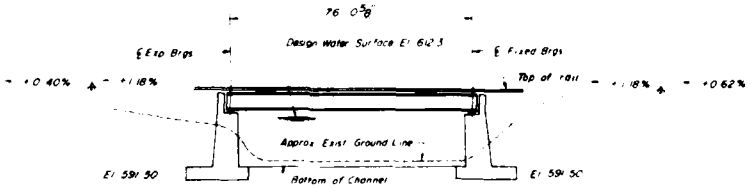
SCALE 1 IN = 20 FT

(B&O VALUATION STA 1292+90)



LOCATION PLAN

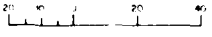
SCALE 1 IN = 20 FT

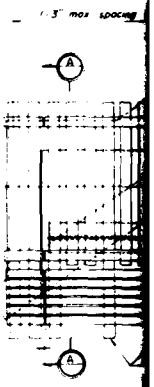


Datum 530.0

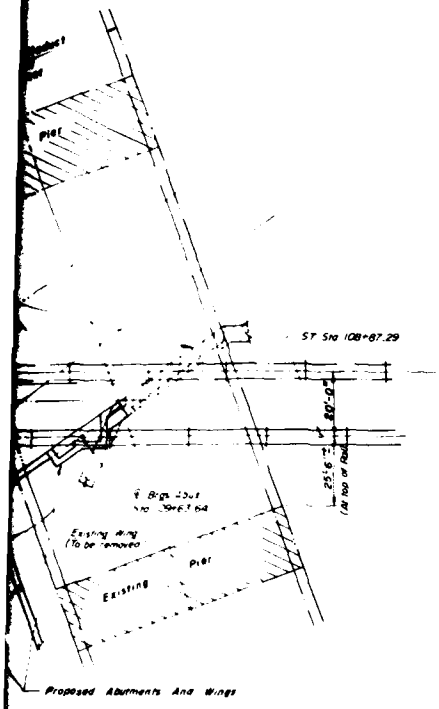
SECTION ALONG ℄ RELOCATED B&O MAINLINE

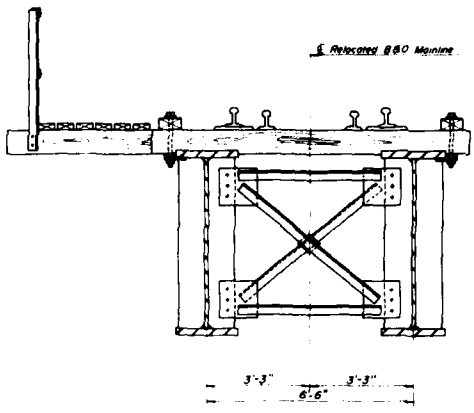
SCALE 1 IN = 20 FT





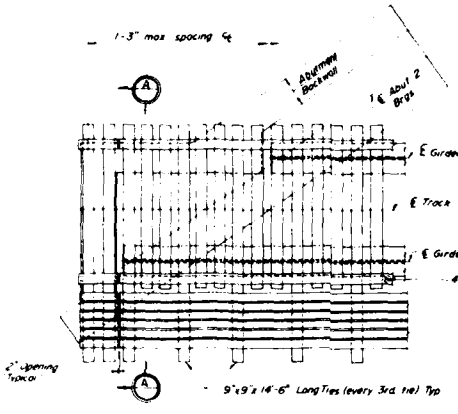
TIE PLAN





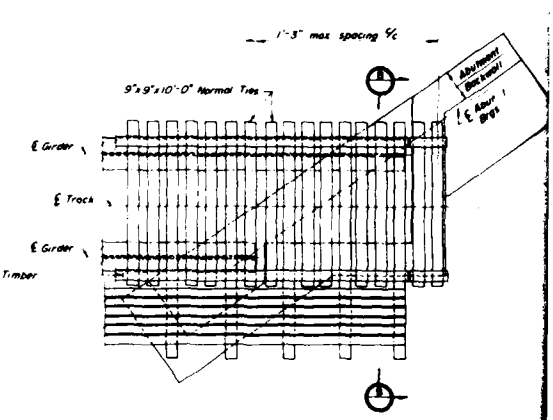
TYPICAL SECTION

SCALE: ½ IN = 1 FT



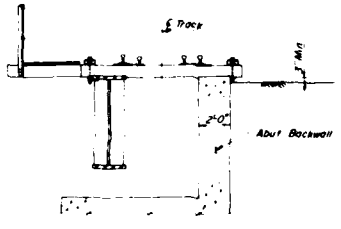
TIE PLAN - ABUTMENT NO. 2

SCALE ¼ IN = 1 FT



TIE PLAN - ABUTMENT NO. 1

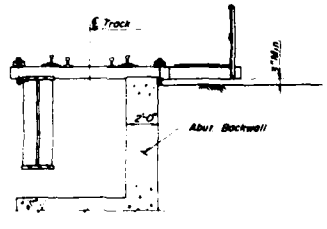
SCALE ¼ IN = 1 FT



SECTION A

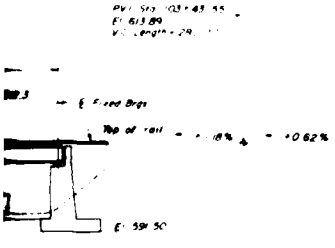
SCALE: ¼ IN = 1 FT

Note For additional details, see Plates 22 and 23



SECTION B

SCALE ¼ IN = 1 FT



B&O MAINLINE

GENERAL NOTES

1 See Plate 26 for General Notes for Bridges

TO ACCOMPANY PHASE II G D M

REV	DATE	DESCRIPTION

U.S ARMY ENGINEER DISTRICT, BUFFALO
CORPS OF ENGINEERS
BUFFALO, NEW YORK 14207

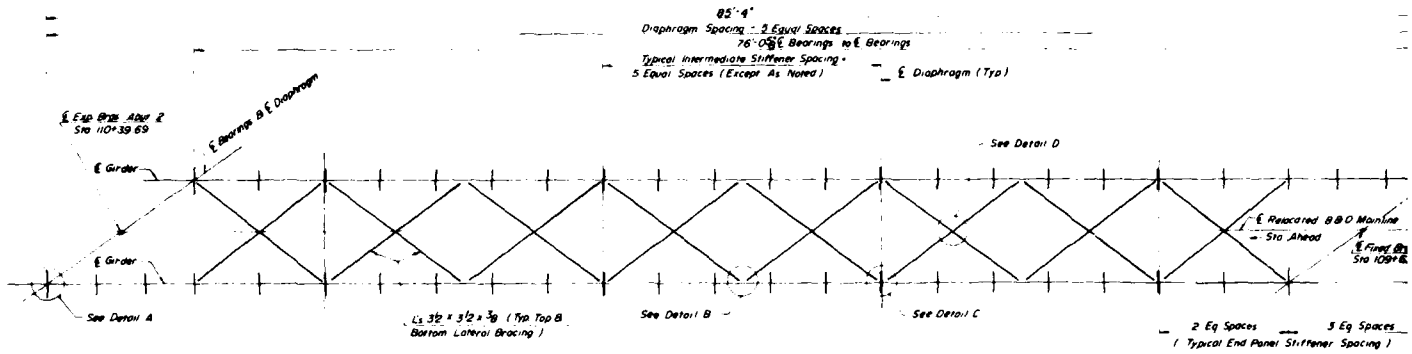
BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

BALTIMORE AND OHIO RAILROAD
MAINLINE BRIDGE NO. 108

GENERAL PLAN

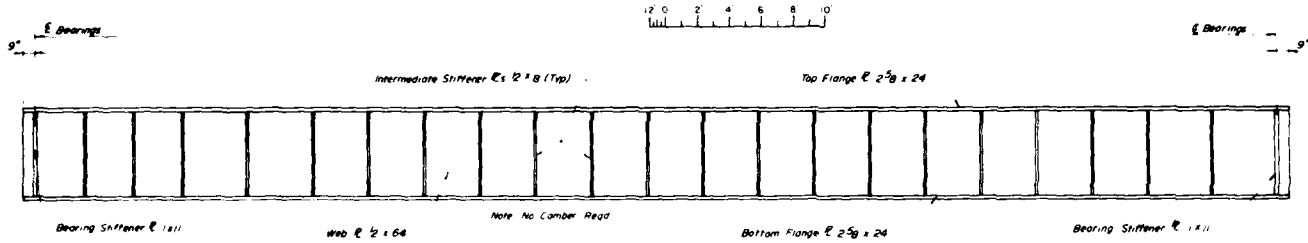
GANNETT FLEMING CORDDRY AND CARPENTER, INC CONSULTING ENGINEERS HARRISBURG, PA	DRAWING NUM
SCALE AS SHOWN	DATE MARCH 1979 SHEET

PLA



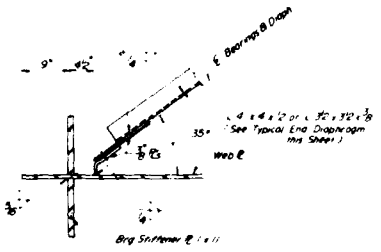
FRAMING PLAN

Scale ¼IN = 1FT



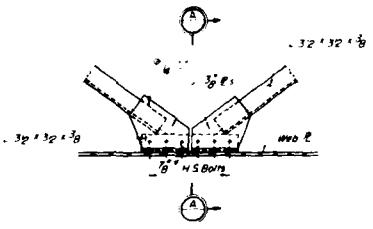
GIRDER ELEVATION

Scale ¼IN = 1FT



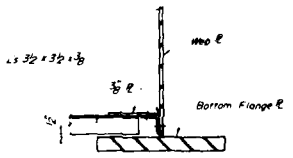
DETAIL A

SCALE 1IN = 1FT



DETAIL B

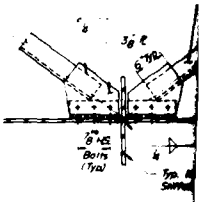
SCALE 1IN = 1FT



SECTION A

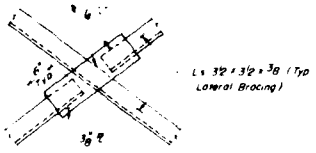
SCALE 1IN = 1FT

Section A-A Typical for all Bottom Lateral Bracing, Top Lateral Bracing Similar)



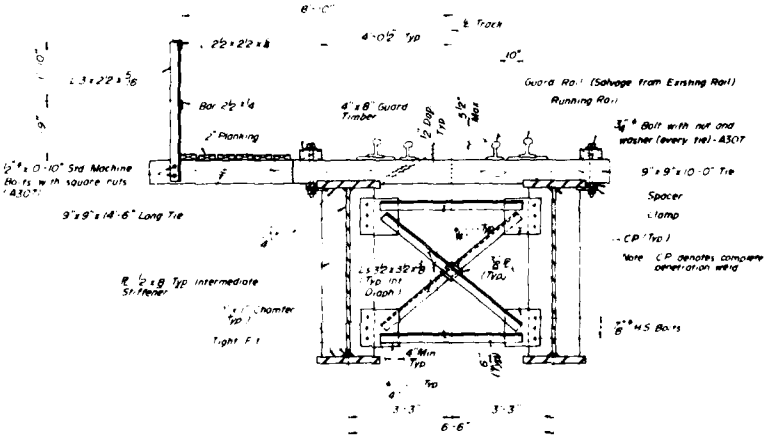
DETAIL C

SCALE 1IN = 1FT



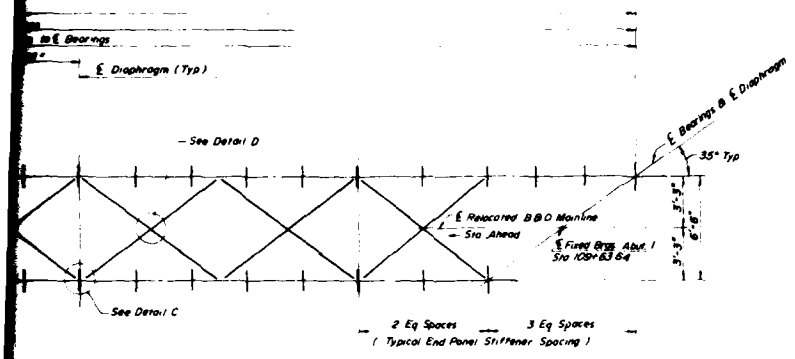
DETAIL D

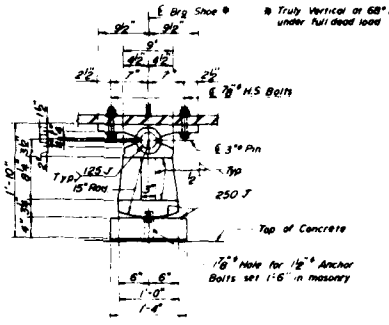
SCALE 1IN = 1FT

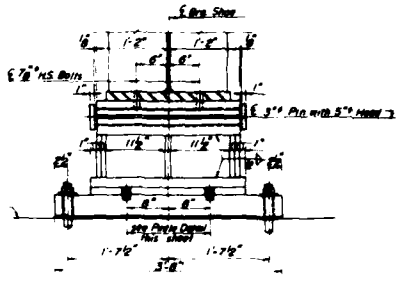


TYPICAL INTERMEDIATE DECK SECTION

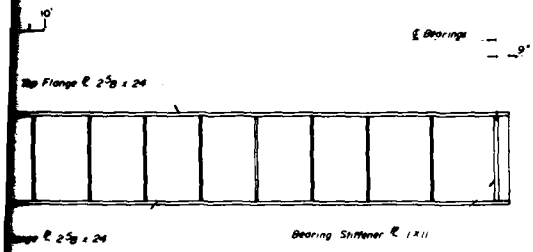
SCALE ½IN = 1FT

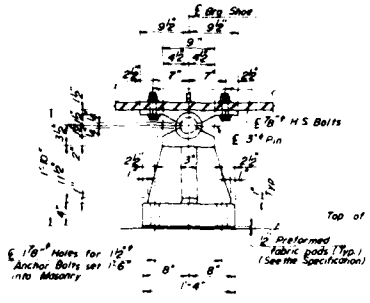


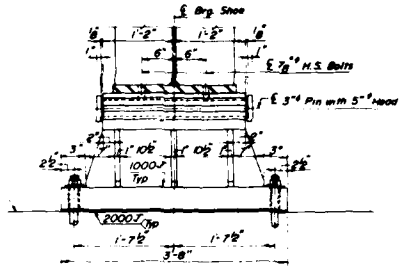




EXPANSION BEARING
SCALE 1 IN = 1 FT







FIXED BEARING
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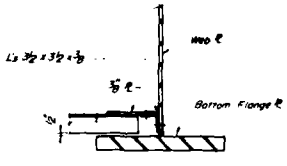
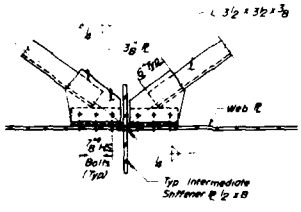
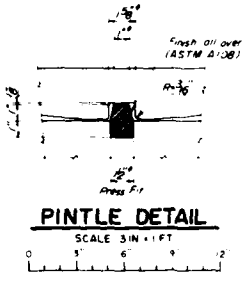


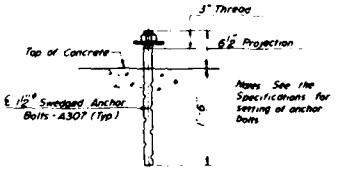
SECTION (A)
SCALE 1 IN = 1 FT
(Section A-A Typical for all Bottom Lateral Bracing, Top Lateral Bracing Similar)



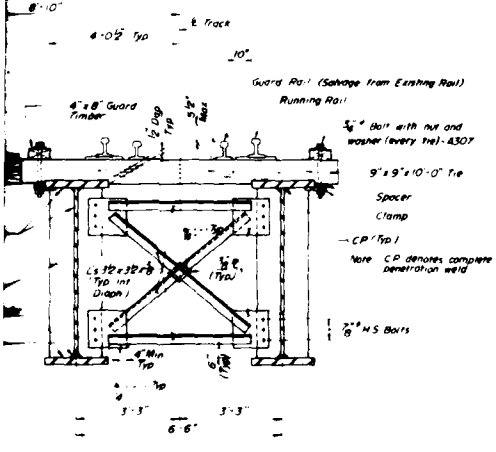
DETAIL C
SCALE 1 IN = 1 FT



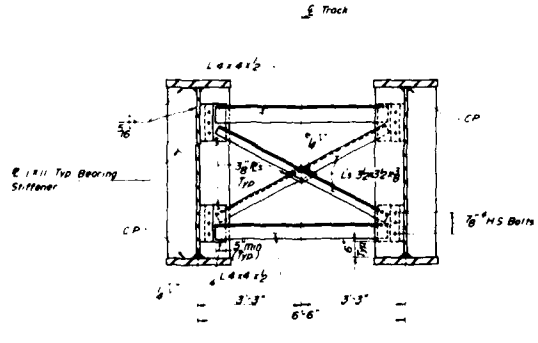
PINTLE DETAIL
SCALE 3 IN = 1 FT



ANCHOR BOLT DETAIL
SCALE 1 IN = 1 FT



INTERMEDIATE DECK SECTION
SCALE 1/2 IN = 1 FT



TYPICAL END DIAPHRAGM
SCALE 1/2 IN = 1 FT
(Shown Normal to ℄ Track)

GENERAL NOTES:

1 For "General Notes for Bridges," see Plate 26

2 For Bearing Shoe Orientation Plan, see Plate 22

TO ACCOMPANY PHASE II G D M

REV	DATE	DESCRIPTION

U.S. ARMY ENGINEER DISTRICT, BUFFALO
CORPS OF ENGINEERS
BUFFALO, NEW YORK 14207

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

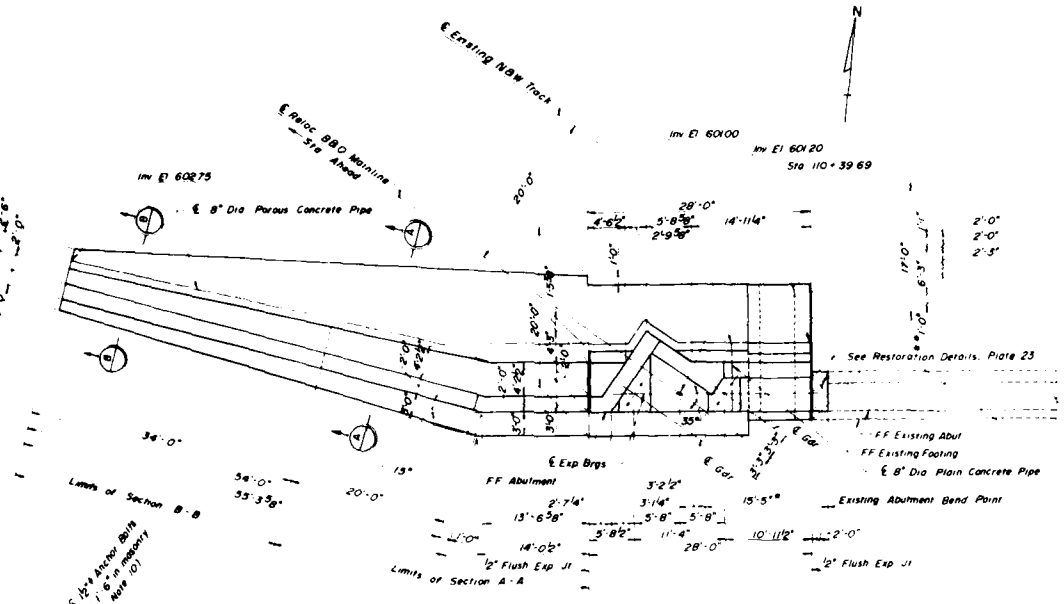
BALTIMORE AND OHIO RAILROAD
MAINLINE BRIDGE NO 108
FRAMING PLAN, GIRDER ELEVATION AND STEEL DETAILS

GANNETT FLEMING CORDDRY AND CARPENTER, INC
CONSULTING ENGINEERS
HARRISBURG, PA

DRAWING NUMB

SCALE AS SHOWN | DATE MARCH 1979 | SHEET

PLATE

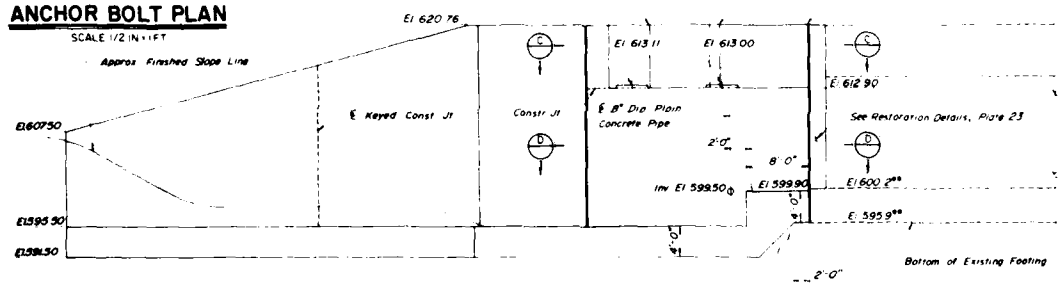


PLAN-ABUTMENT NO. 2

SCALE 1/8 IN = 1 FT

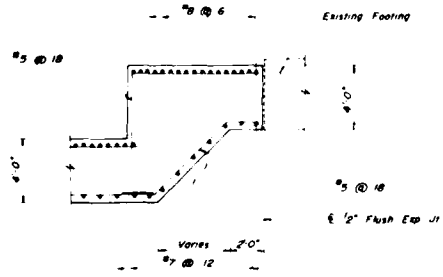
ANCHOR BOLT PLAN

SCALE 1/2 IN = 1 FT



ELEVATION-ABUTMENT NO. 2

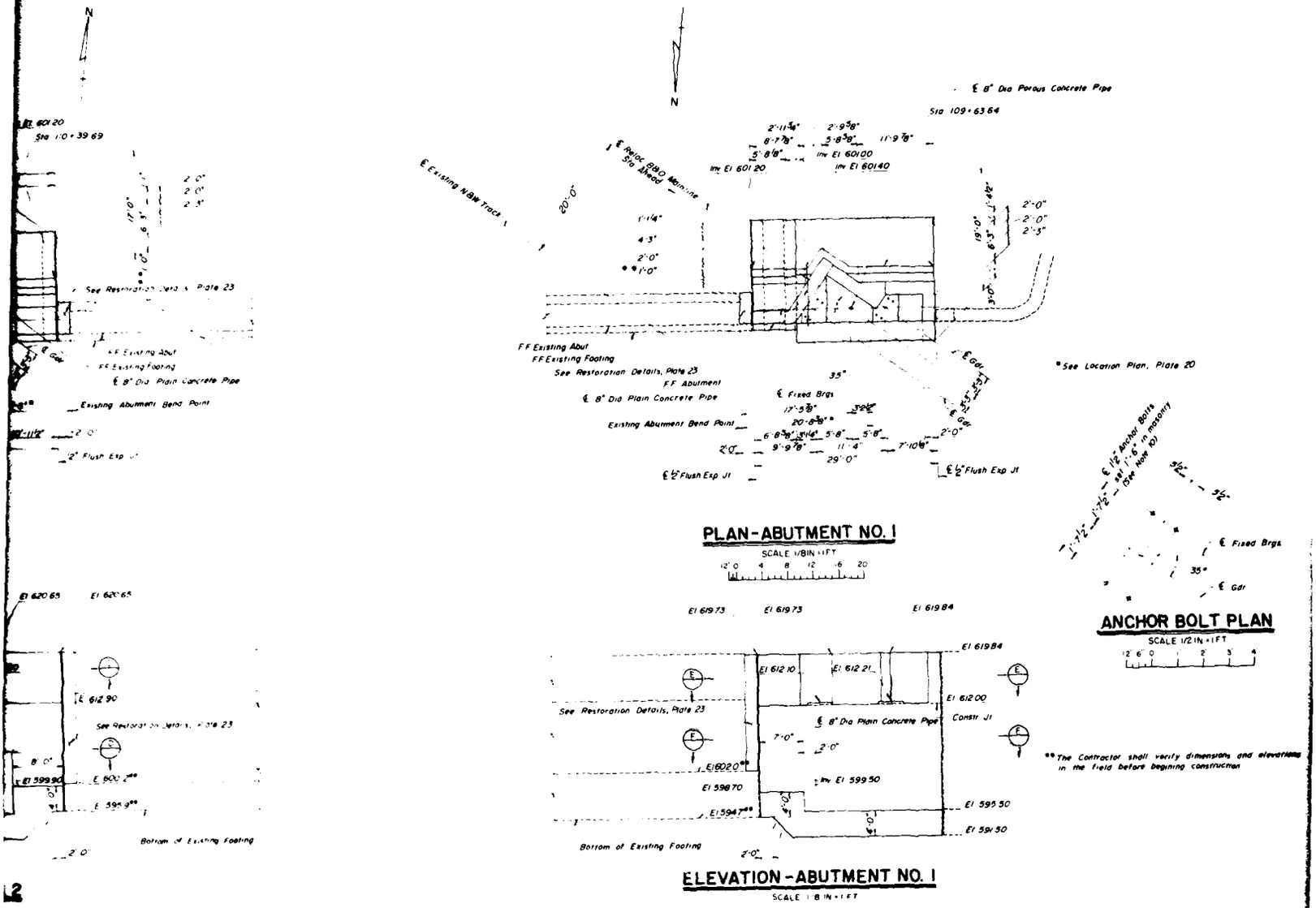
SCALE 1/8 IN = 1 FT



FOOTING STEP DETAIL

(Abut No 2 shown Abut No 1 similar)

SCALE 1/4 IN = 1 FT



PLAN - ABUTMENT NO. 1

SCALE 1/8 IN = 1 FT

ELEVATION - ABUTMENT NO. 1

SCALE 1/8 IN = 1 FT

ANCHOR BOLT PLAN

SCALE 1/2 IN = 1 FT

GENERAL NOTES

1. For General Notes, see Plate 26
2. For General Plan, see Plate 20
3. For Framing Plan, see Plate 21
4. For Bearing Shoe Details, see Plate 21
5. For Anchor Bolt Details, see Plate 21
6. For Typical Sections, see Plate 23
7. For Construction and Expansion Joint Details, see Plate 29
8. Minimum reinforcement bar lap splice shall be 30 Diameters unless noted
9. Maximum Design Foundation Pressure 4.5 Tons / S.F.
10. Anchor bolts shall be set in 3½" x 1'-6" predrilled holes and filled with non shrink grout

TO ACCOMPANY PHASE II GDM

REV	DATE	DESCRIPTION

U.S ARMY ENGINEER DISTRICT, BUFFALO
CORPS OF ENGINEERS
BUFFALO, NEW YORK 14207

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

BALTIMORE AND OHIO RAILROAD
MAINLINE BRIDGE NO 108
ABUTMENTS
PLAN AND ELEVATION

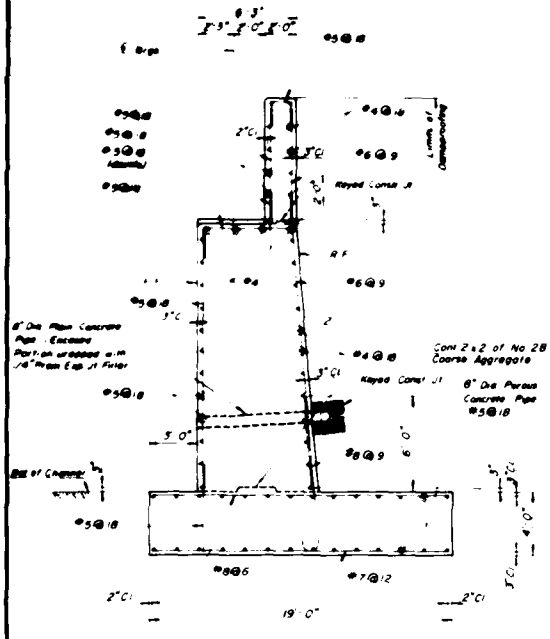
GANNETT FLEMING CORDDRY AND CARPENTER, INC
CONSULTING ENGINEERS

DRAWING NUMBER

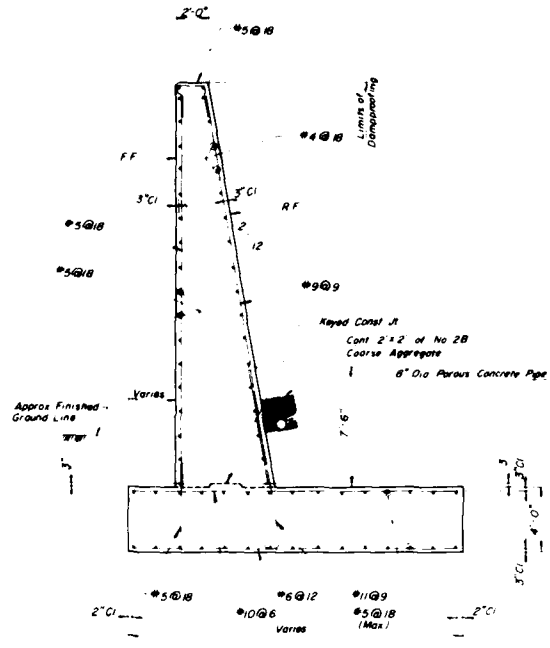
SCALE AS SHOWN | DATE MARCH 1979 | SHEET

PL

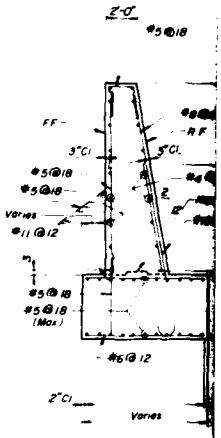
2



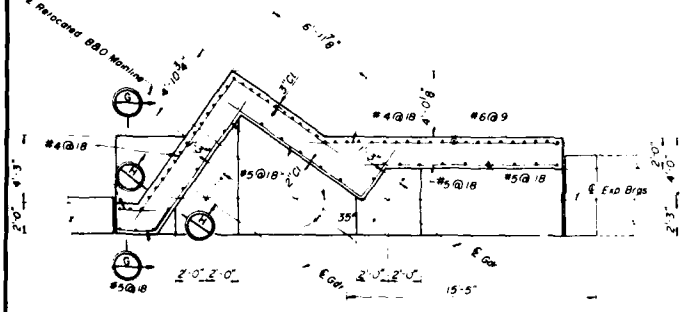
TYPICAL SECTION
SCALE 1/4 IN = 1FT



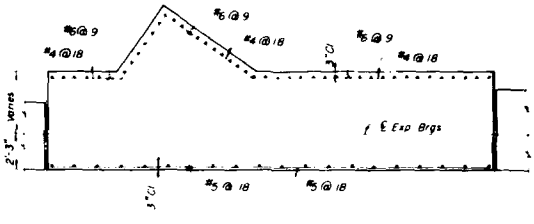
SECTION (A)
SCALE 1/4 IN = 1FT



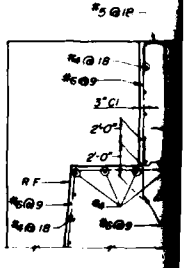
SECTION (B)
SCALE 1/4 IN = 1FT



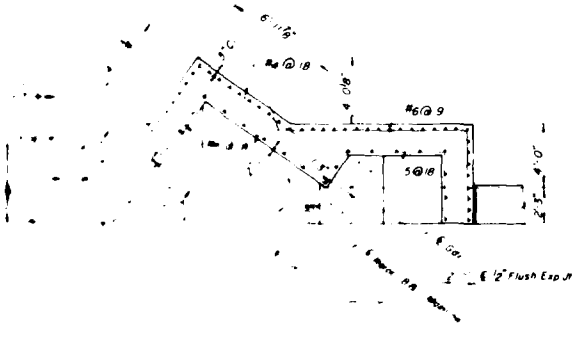
SECTION (C)
SCALE 1/4 IN = 1FT

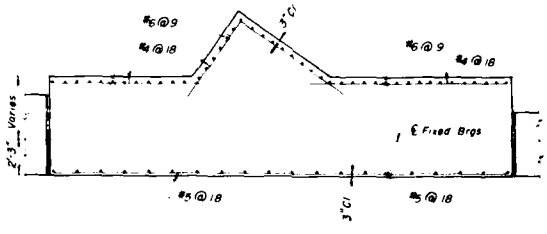


SECTION (D)
SCALE 1/4 IN = 1FT

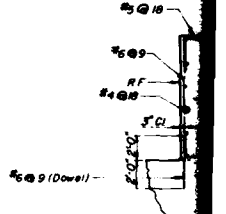


SECTION (E)
SCALE 1/4 IN = 1FT

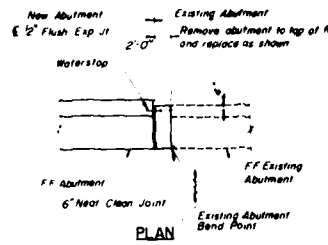




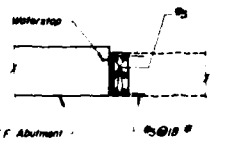
SECTION (F)
SCALE 1/4 IN = 1FT



SEC
SCALE

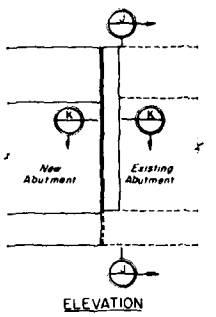


PLAN

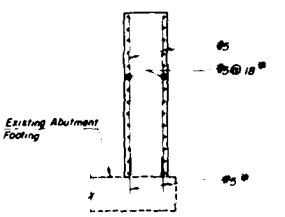


SECTION

* Dowels shall be set in predrilled holes 1⅝"ø x 1'-6" and filled with non-shrink grout



ELEVATION

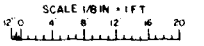


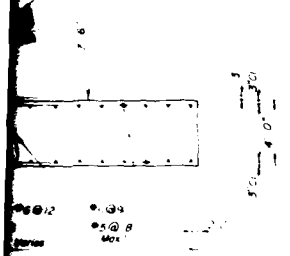
SECTION

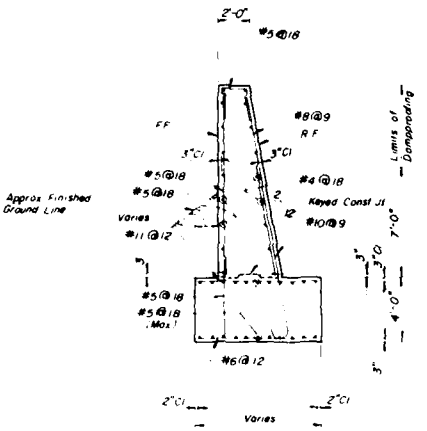
RESTORATION DETAILS

ABUTMENT NO 2

SCALE 1/8 IN = 1 FT





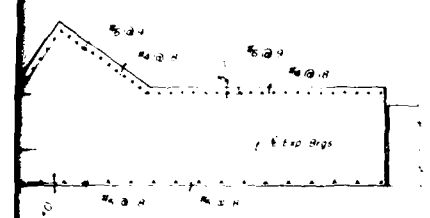


SECTION

SCALE 1/4 IN = 1 FT

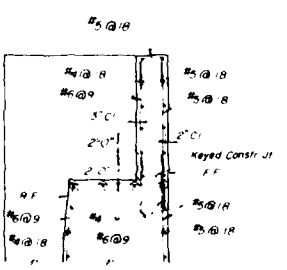
SECTION

SCALE 1/4 IN = 1 FT



SECTION

SCALE 1/4 IN = 1 FT



SECTION

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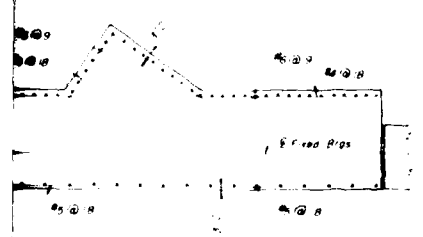
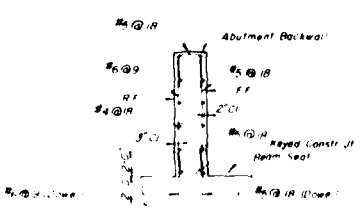


SECTION

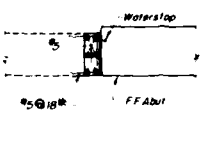
SCALE 1/4 IN = 1 FT



SECTION

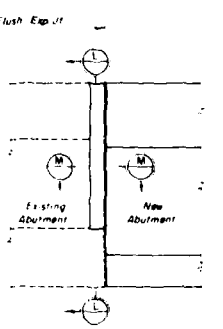
SCALE 1/4 IN = 1 FT

PLAN

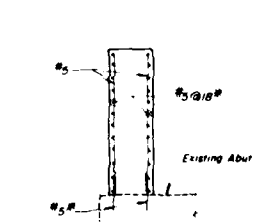


SECTION

* Dowels shall be set in predrilled holes 1⅝"ø x 1'-6" and filled with non-shrink grout



ELEVATION



SECTION

RESTORATION DETAILS

ABUTMENT NO 1

SCALE 1/8 IN = 1 FT

GENERAL NOTES

Sections A thru L Typical Section Plate 25

1. For General Notes, see Plate 26
2. For General Plan, see Plate 20
3. For Abutment Plan and Elevation, see Plate 22
4. Max Design Foundation Pressure = 4.7 Tons / S F

TO ACCOMPANY PHASE II G D M

REV	DATE	DESCRIPTION

U.S ARMY ENGINEER DISTRICT, BUFFALO
CORPS OF ENGINEERS
BUFFALO, NEW YORK 14207

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

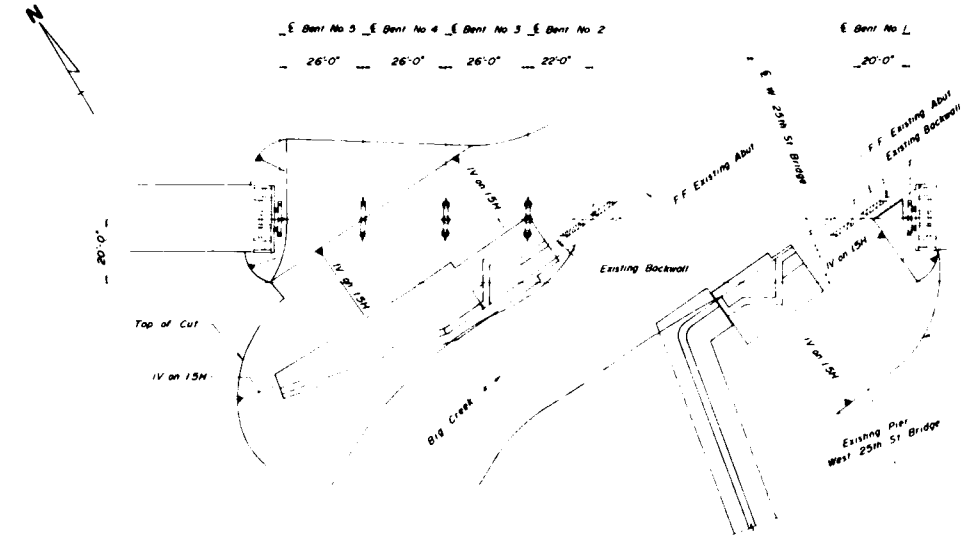
BALTIMORE AND OHIO RAILROAD
MAINLINE BRIDGE NO 108
ABUTMENTS
SECTIONS AND DETAILS

GANNETT FLEMING CORDDRY AND CARPENTER, INC
CONSULTING ENGINEERS
HARRISBURG PA

DRAWING NUMBER

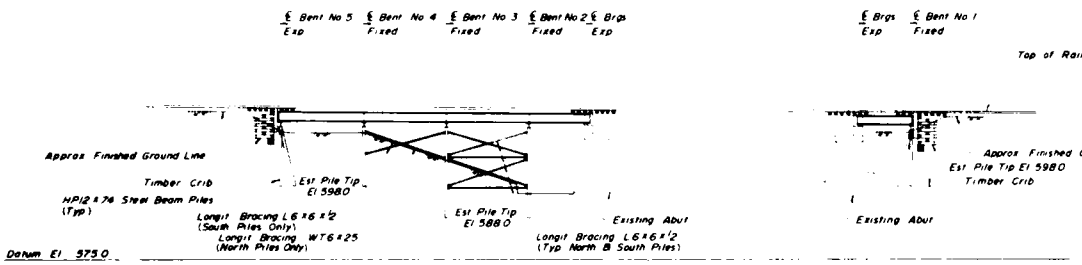
SCALE AS SHOWN | DATE MARCH 1979 | SHEET

PLATE



GENERAL PLAN

SCALE 1 IN = 20 FT



SECTION ALONG ℄ EXISTING N & W TRACK

SCALE 1 IN = 20 FT

CONSTRUCTION SEQUENCE

Stage I - Construct Temporary Steel Trestle for Norfolk and Western RR

1. Drive steel bearing piles for steel trestle bents. Piles noted (24) shall be placed in preaugered holes and grouted to top of rock
2. Place bent caps
3. Construct timber crib abutments and modify backwalls to support temporary stringers
4. Remove existing rail, ties and tie plates and stockpile for re-use. Excavate to a depth sufficient to erect temporary spans
5. Erect temporary stringers
6. Place rail on temporary trestle and restore track to service

Note - All staging of work for construction of temporary trestle shall be submitted to the Norfolk and Western for their approval and to arrange for inspection and protection personnel. The Contractor is permitted 2 working days to erect the temporary trestle spans.

Stage II - Construct New Abutments for the Baltimore and Ohio Bridge #108

1. Excavate for the footings of abutments and retaining walls
2. Remove portion of existing retaining walls to construct new footings
3. Construct new abutments and retaining walls
4. Backfill new abutments and retaining walls to bottom of temporary stringers

Note - The contractor is responsible for the stability of the existing abutments during the construction of the new substructure. Any loss of revenue to the Norfolk and Western due to the contractors negligence shall be borne by the contractor.

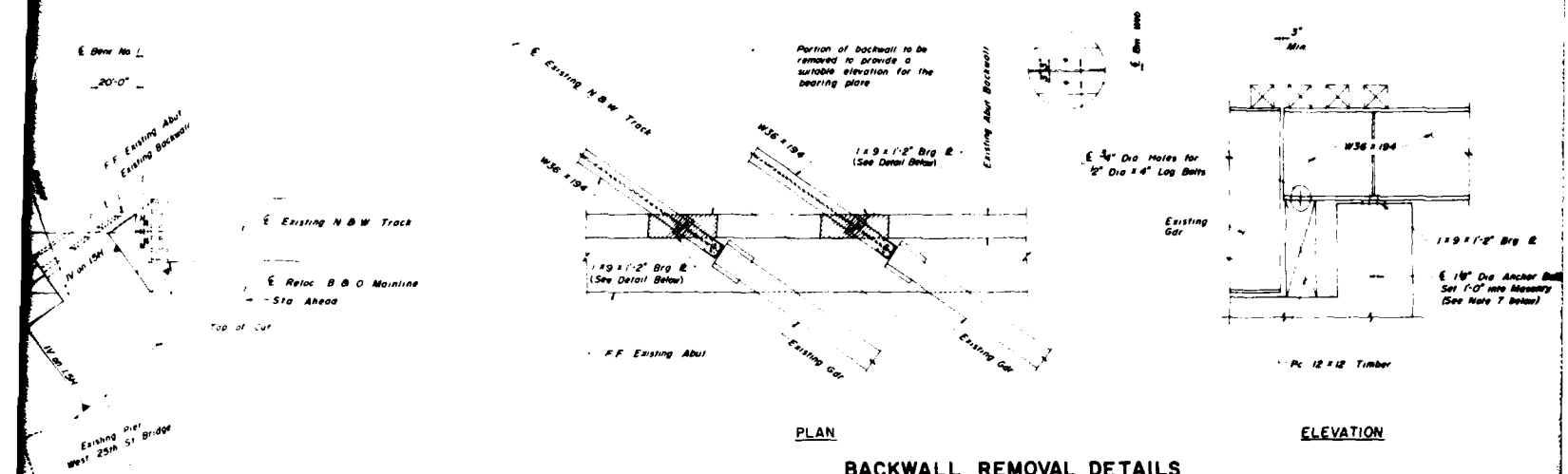
Stage III - Restore Norfolk and Western to Original Condition

1. Dismantle temporary trestle, restore existing backwalls and remove timber crib abutments
2. Backfill, placing sub-base and ballast
3. Re-using existing ties and track material, restore track to service

Stage IV - Complete Construction of New Baltimore and Ohio Bridge #108

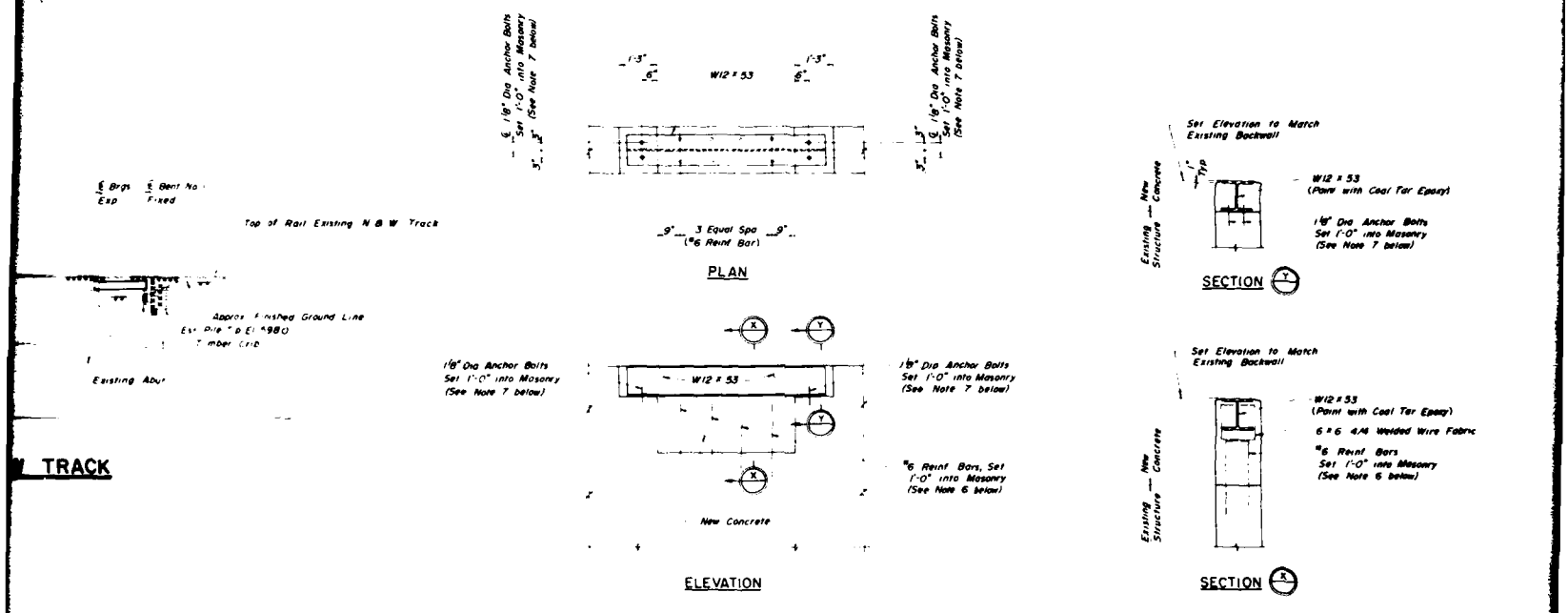
1. Erect new superstructure and place ties
2. Lay new rail over structure tying into relocated track

Note - For additional information see the Specifications



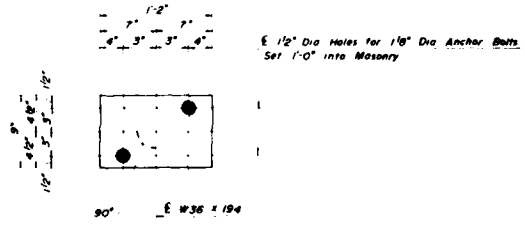
BACKWALL REMOVAL DETAILS

NO SCALE



BACKWALL RESTORATION DETAILS

NO SCALE



BEARING ℄ DETAIL

NO SCALE

TRACK

...sponsible for the stability of the existing ...e construction of the new substructure. Any loss ...folk and Western due to the contractors ...e borne by the contractor

...and Western to Original Condition ...e trestle, restore existing backwalls and remove ...ete ...sub-base and ballast ...ties and track material, restore track to service

...ion of New Baltimore and Ohio Bridge #108 ...ishore and place ties ...structure trying into relocated track

...ination see the Specifications

GENERAL NOTES

1. For General Notes, see Plate 26
2. Max Design Pile Load = 88 Tons
3. ⊢ Denotes 3:12 battered pile and direction of batter
4. (H) Denotes Augered Pile
5. For trestle bent details, see Plate 25
6. Reinf bars shall be set in 1-3/4" x 1'-0" predrilled holes and filled with non-shrink grout
7. Anchor bolts shall be set in 3" x 1'-0" predrilled holes and filled with non-shrink grout

TO ACCOMPANY PHASE II GDM

REV	DATE	DESCRIPTION

U.S. ARMY ENGINEER DISTRICT, BUFFALO
CORPS OF ENGINEERS
BUFFALO, NEW YORK 14207

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

NORFOLK AND WESTERN RAILROAD
TEMPORARY STRUCTURE
PLAN AND ELEVATION

GANNETT FLEMING CORDDRY AND CARPENTER, INC
CONSULTING ENGINEERS
HARRISBURG, PA

DRAWING NUMBER

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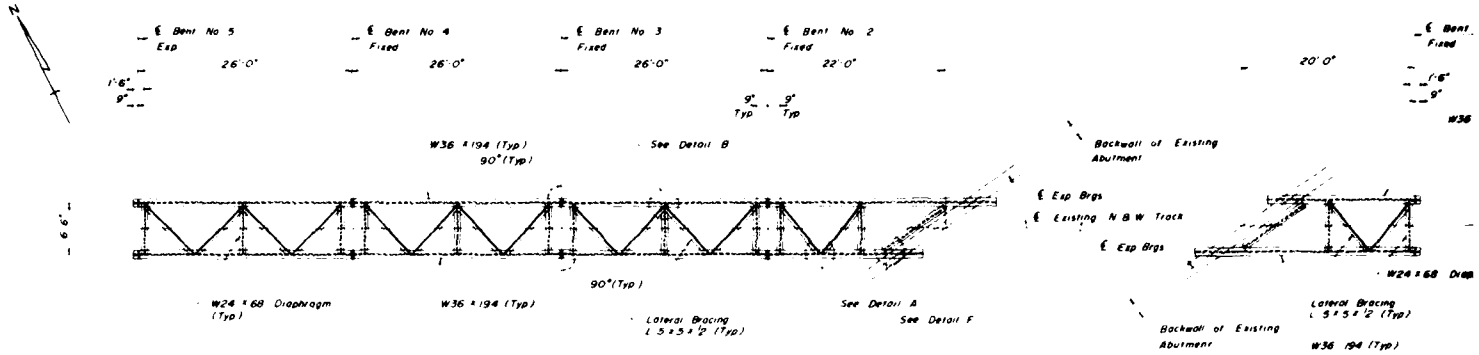
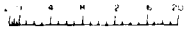
PL...

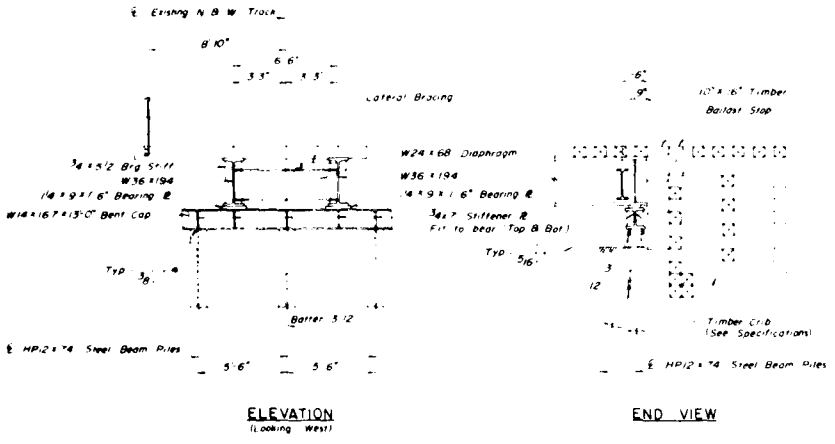
2



FRAMING PLAN

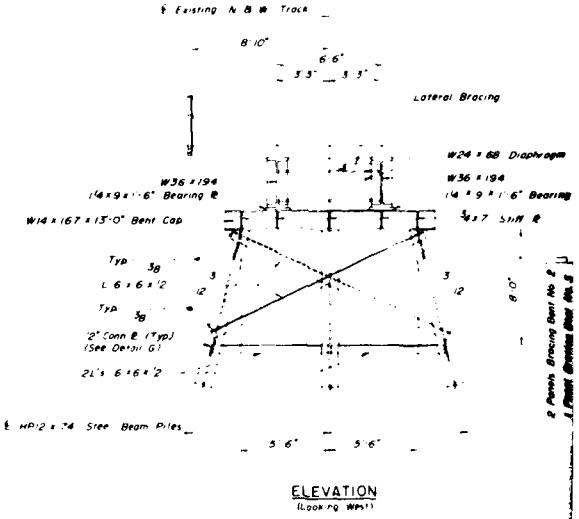
SCALE 1/8 IN = 1 FT





ELEVATION
(Looking West)

END VIEW



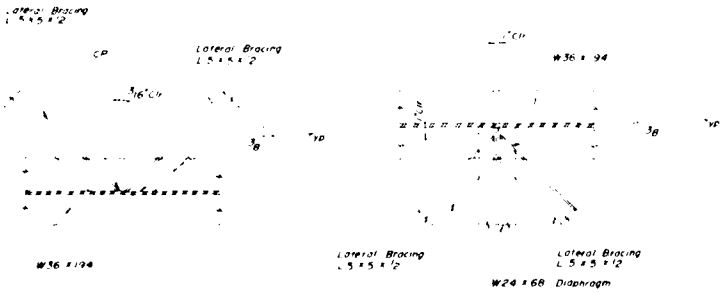
BENT NO. 1 & 5

SCALE 1/4 IN = 1 FT

ELEVATION
(Looking West)

BENT NO. 2

SCALE 1/4 IN = 1

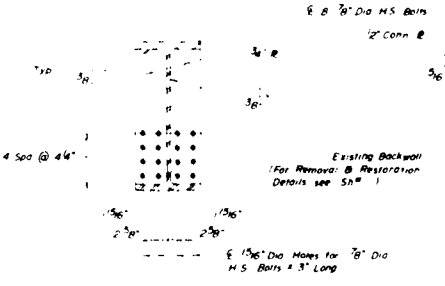


DETAIL A

NO SCALE

DETAIL B

NO SCALE



BEAM CONNECTION DETAIL

NO SCALE

1/4" Dia Holes for 7/8" Dia Bolts at Fixed End
1/4" x 2" Slotted Holes for 7/8" Dia Bolts at Expansion End

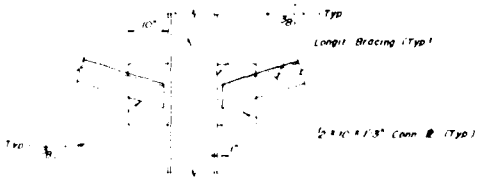
SECTION

NO SCALE

1/4" Dia Holes for 7/8" Dia Bolts over Bents

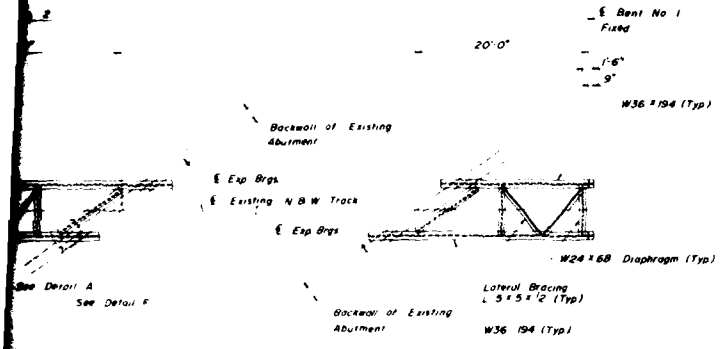
SECTION

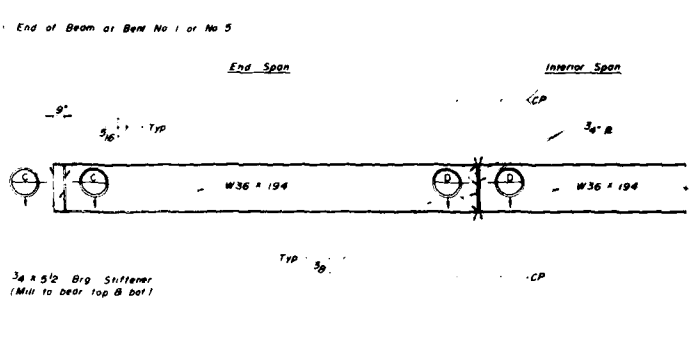
NO SCALE



DETAIL G

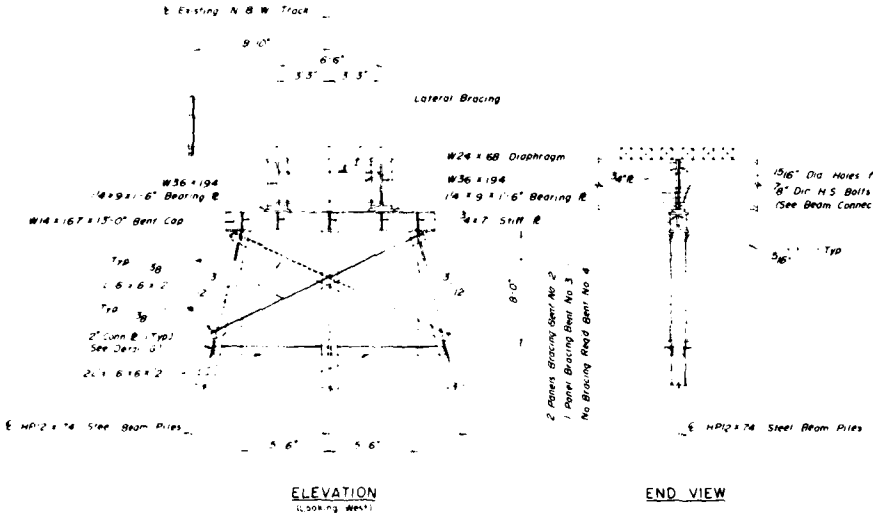
NO SCALE





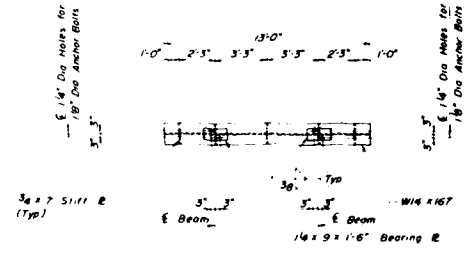
PART BEAM ELEVATION

NO SCALE



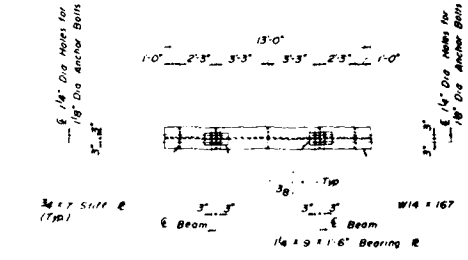
ELEVATION
(Looking West)

END VIEW



BENT CAP DETAIL

(BENT NO 1 & 5)
SCALE 1/4 IN = 1 FT

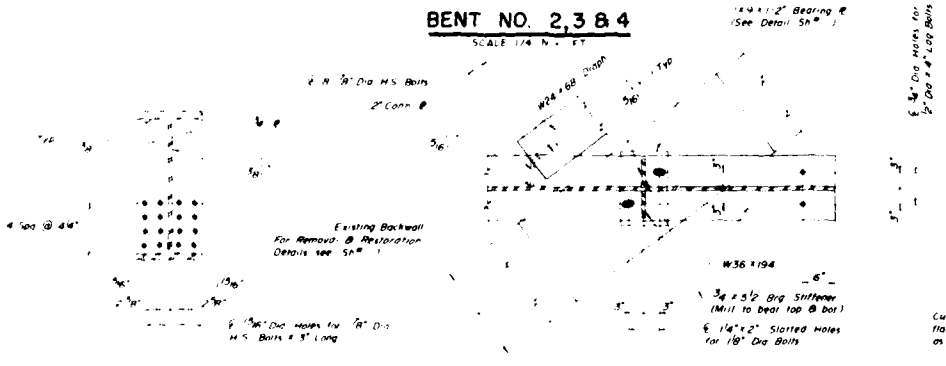


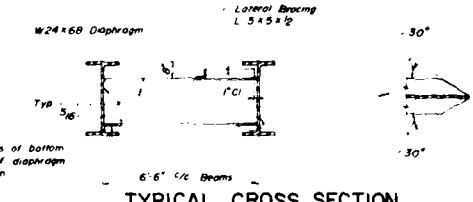
BENT CAP DETAIL

(BENT NO 2,3 & 4)
SCALE 1/4 IN = 1 FT

BENT NO. 2,3 & 4

SCALE 1/4 IN = 1 FT





BEAM CONNECTION DETAIL

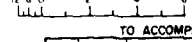
NO SCALE

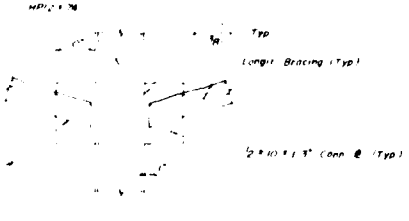
DETAIL F

NO SCALE

TYPICAL CROSS SECTION

SCALE 3/8 IN = 1 FT





DETAIL G

NO SCALE

GENERAL NOTES

1. For General Plan and Construction Sequence, see Plate 24
2. For General Notes, see Plate 26
3. For deck details not shown see Typical Intermediate Deck Section, Plate 21
4. Max Design Pile Load = 88 Tons
5. The Contractor shall verify all dimensions and elevations on existing abutments in the field before beginning construction

TO ACCOMPANY PHASE II GDM

REV	DATE	DESCRIPTION

U.S ARMY ENGINEER DISTRICT, BUFFALO
CORPS OF ENGINEERS
BUFFALO, NEW YORK 14207

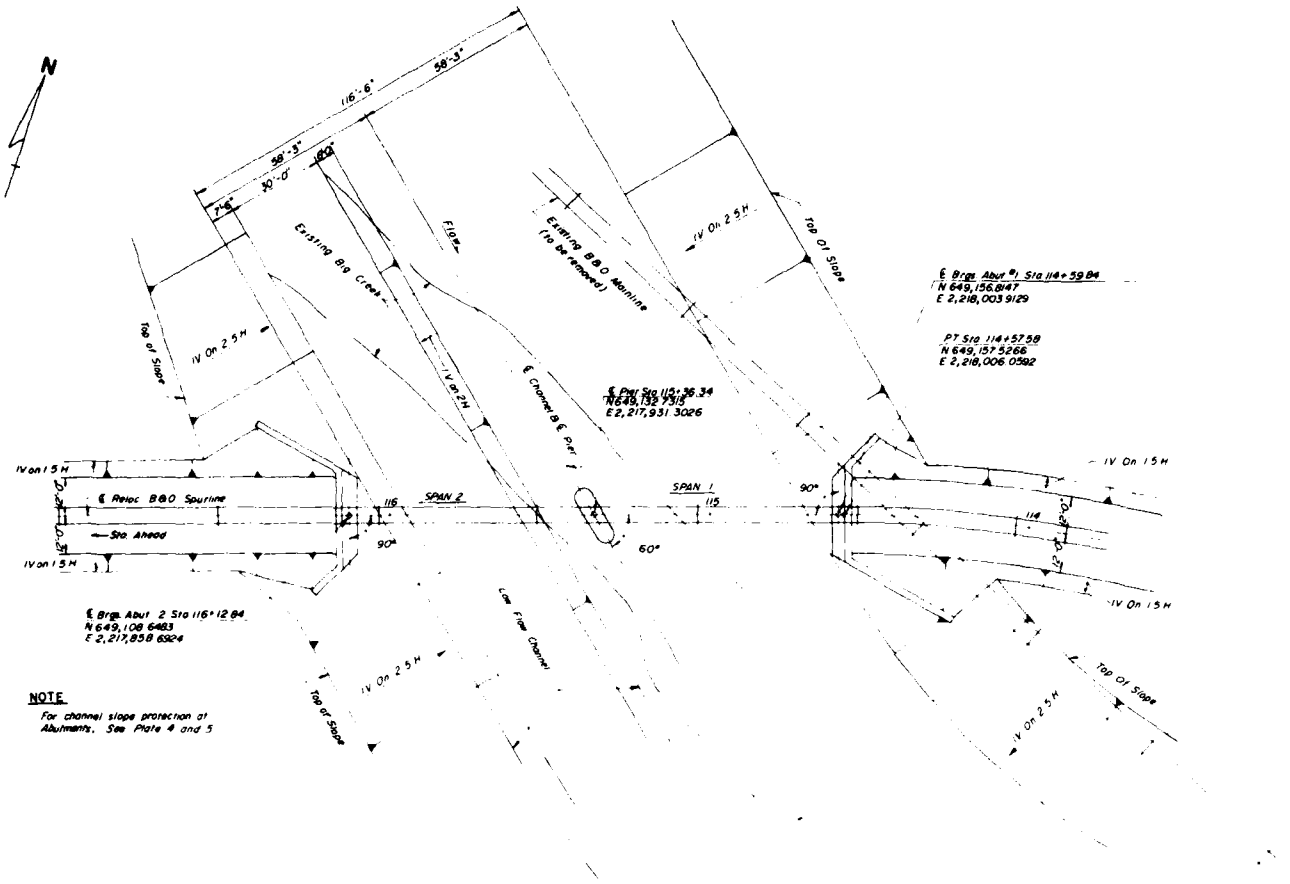
BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

NORFOLK AND WESTERN RAILROAD
TEMPORARY STRUCTURE

DETAILS

GANNETT FLEMING CORDDRY AND CARPENTER, INC CONSULTING ENGINEERS HARRISBURG, PA.	DRAWING NUMBER
SCALE AS SHOWN	DATE MARCH 1979 SHEET

PLATE



NOTE

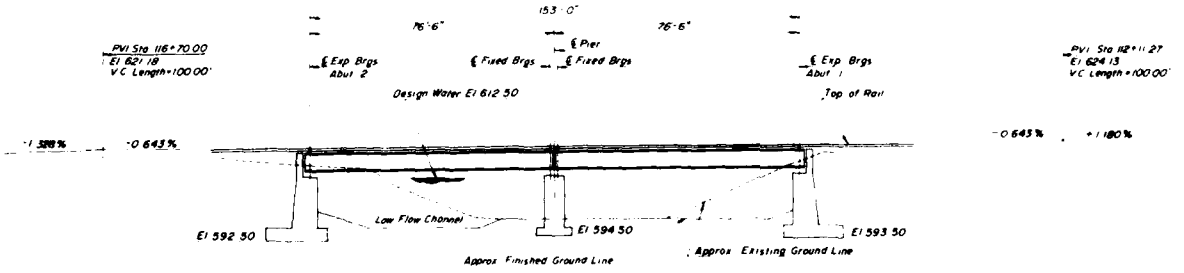
For channel slope protection at Abutments, See Plate 4 and 5

GENERAL PLAN

SCALE 1 IN = 20 FT

(B&O VALUATION STA 115+36.34)

20' 10 0 20 40



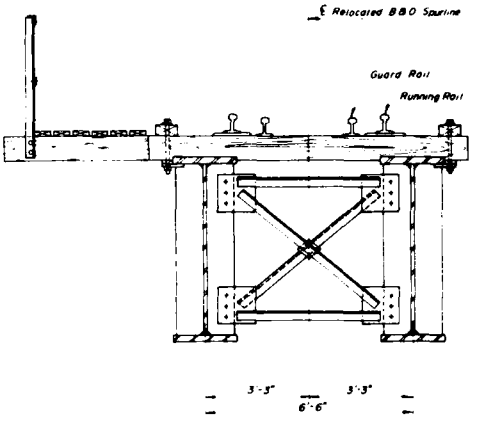
Datum El 550.0

SECTION ALONG ℄ RELOCATED B&O SPURLINE

SCALE 1 IN = 20 FT

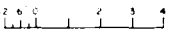
GENERAL NO

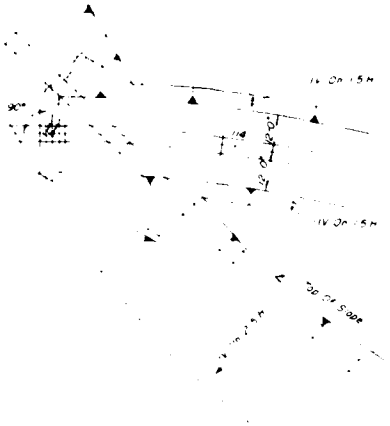
1 A
2 Design
with
3 All
1977
4 Structure
5 All bolts
6 Concrete
7 All exp
8 Steel
9 Structure
wings
10 Dampen
and
11 Abutme
against
rock
12 The
13 Foundat
14 Tempora
Specifi
15 All

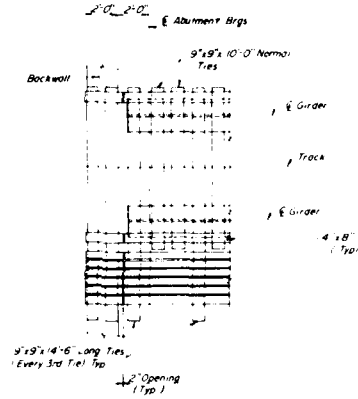


TYPICAL SECTION

SCALE 1/2 IN = 1 FT

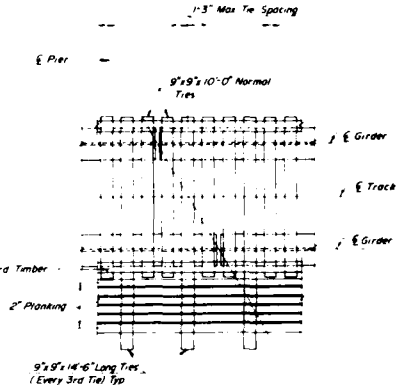






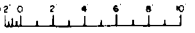
TIE PLAN AT ABUTMENTS

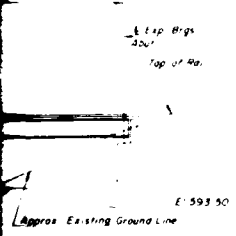
SCALE 1/4 IN = 1 FT



TIE PLAN AT PIER

SCALE 1/4 IN = 1 FT





GENERAL NOTES FOR BRIDGES

1. All materials and workmanship shall be in accordance with the Specifications.
2. Design Criteria: A.R.E.A. 1975 Specifications. Live Load for superstructure design is Cooper E80 Loading with diesel impact. Live Load for substructure design is Cooper E72 Loading without Impact.
3. All welding shall be in accordance with the A.W.S. Structural Welding Code D1.1-75 including 1976 and 1977 Revisions.
4. Structural Steel shall conform to A.S.T.M. A36.
5. All bolted connections shall be made with $\frac{7}{8}$" H.S. Bolts (A.S.T.M. A325) except as noted.
6. Concrete shall have a minimum 28 day strength of $f'_c = 3000$ p.s.i.
7. All exposed edges shall be chamfered 1" x 1".
8. Steel Reinforcement shall conform to A.S.T.M. A615 or A617, Grade 40.
9. Structure Backfill shall conform to the Specifications and shall be placed behind abutments and wings as shown on plans.
10. Damproofing shall conform to the Specifications and shall be applied to the rear faces of abutments and wings as shown on the plans.
11. Abutment and wing foundation concrete shall be placed so that the vertical face of the toe bears against sound rock. Care shall be taken during excavation to maintain the integrity of the vertical rock cut.
12. The contractor shall verify all pertinent dimensions of the existing N.B.W. Bridge in the field.
13. Foundations shall be placed on rock. Maximum allowable design foundation pressure = 5 tons/sq. ft.
14. Temporary Trestle for the N.B.W. Mainline shall be constructed in accordance with the Plans and Specifications. For Temporary Trestle Notes and Construction Sequence, see Plate 24.
15. All ties supported on the backwalls shall be box anchored. (four rail anchors per tie.)

TO ACCOMPANY PHASE II GDM

REV	DATE	DESCRIPTION

U.S. ARMY ENGINEER DISTRICT, BUFFALO
CORPS OF ENGINEERS
BUFFALO, NEW YORK 14207

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

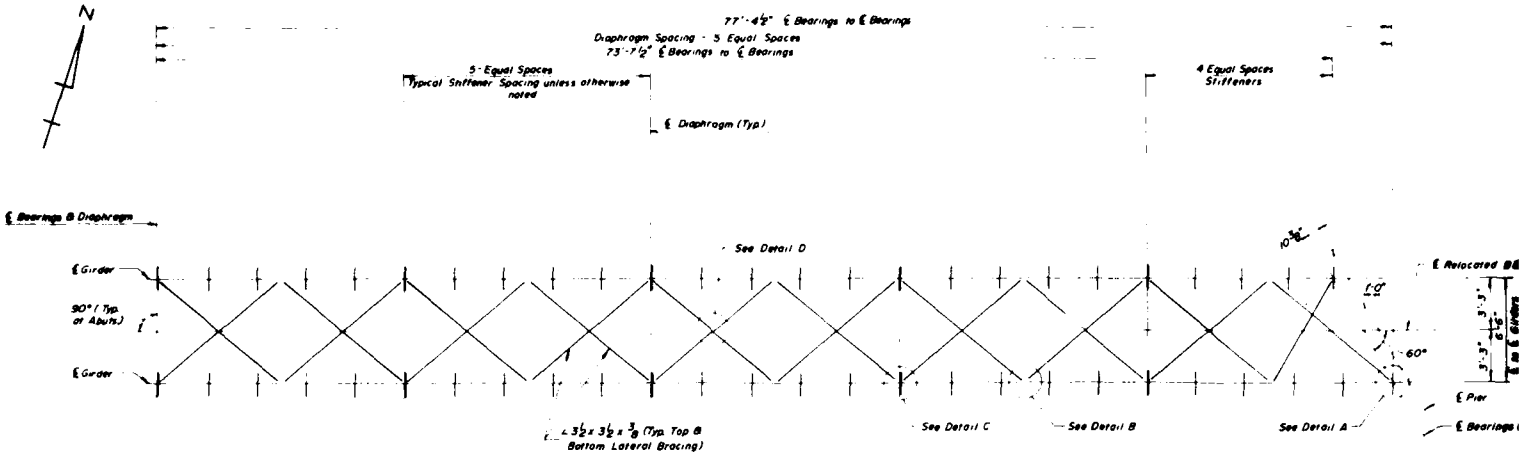
BALTIMORE AND OHIO RAILROAD
SPURLINE BRIDGE NO. 108/1
GENERAL PLAN AND
GENERAL NOTES FOR BRIDGES

GANNETT FLEMING CORDDRY AND CARPENTER, INC
CONSULTING ENGINEERS
HARRISBURG, PA.

DRAWING NUMBER

SCALE AS SHOWN | DATE MARCH 1979 | SHEET

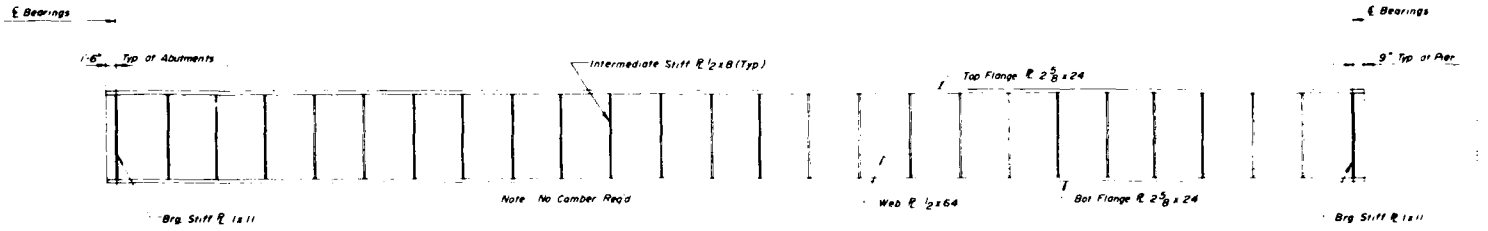
PLATE



FRAMING PLAN

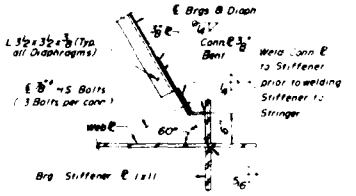
SCALE 1/4 IN. = 1 FT

Span 2 shown, Span 1 similar see Key Plan, this sheet



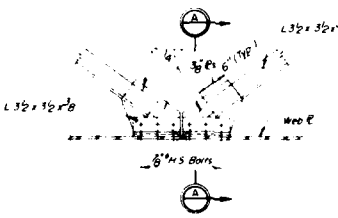
GIRDER ELEVATION

SCALE 1/4 IN. = 1 FT



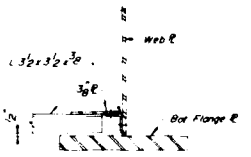
DETAIL A

SCALE 1 IN. = 1 FT



DETAIL B

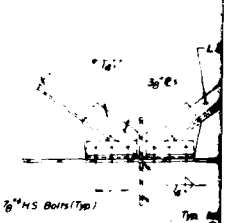
SCALE 1 IN. = 1 FT



SECTION (A)

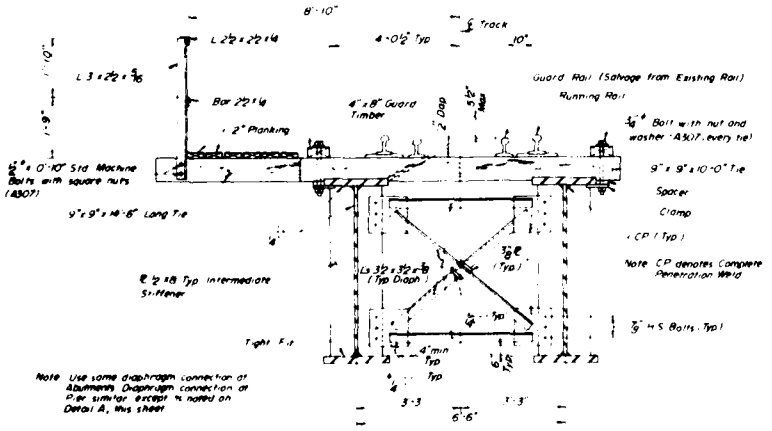
SCALE 1 IN. = 1 FT

(Section A-A Typical for all Bottom Lateral Bracing, Top Lateral Bracing similar.)



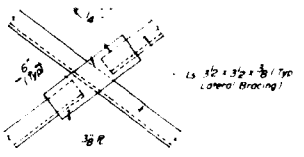
DETAIL C

SCALE 1 IN. = 1 FT



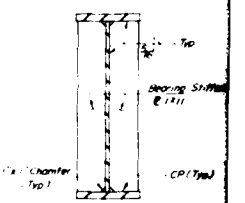
TYPICAL INTERMEDIATE DECK SECTION

SCALE ½ IN. = 1 FT



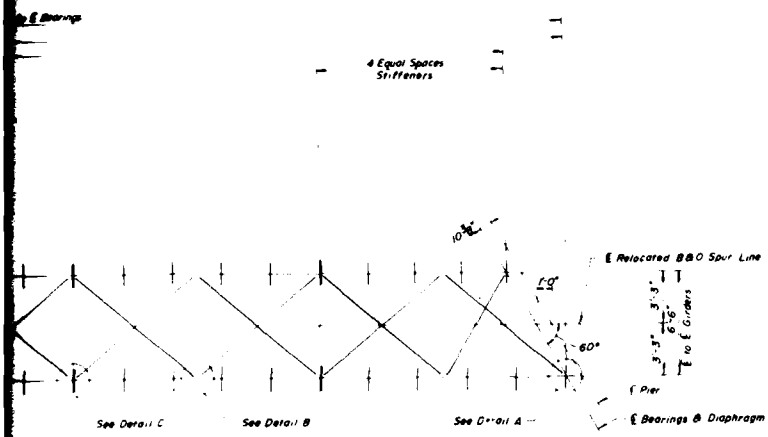
DETAIL D

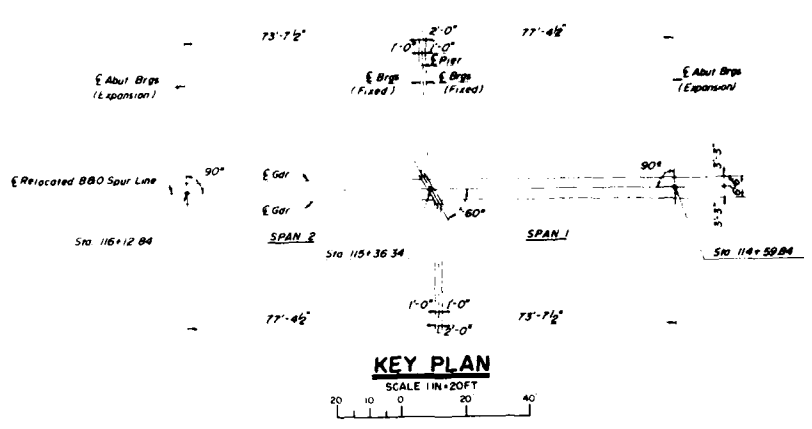
SCALE 1 IN. = 1 FT



BEARING STIFFENER DE

SCALE ½ IN. = 1 FT

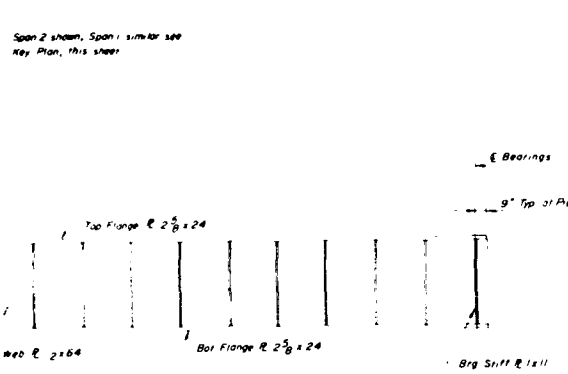


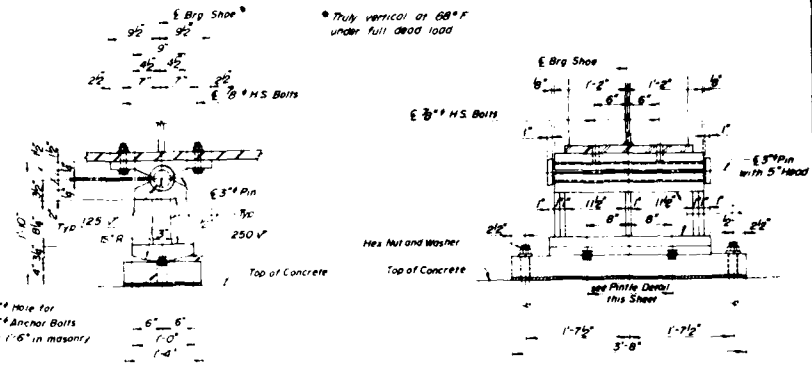


KEY PLAN

SCALE 1 IN = 20 FT

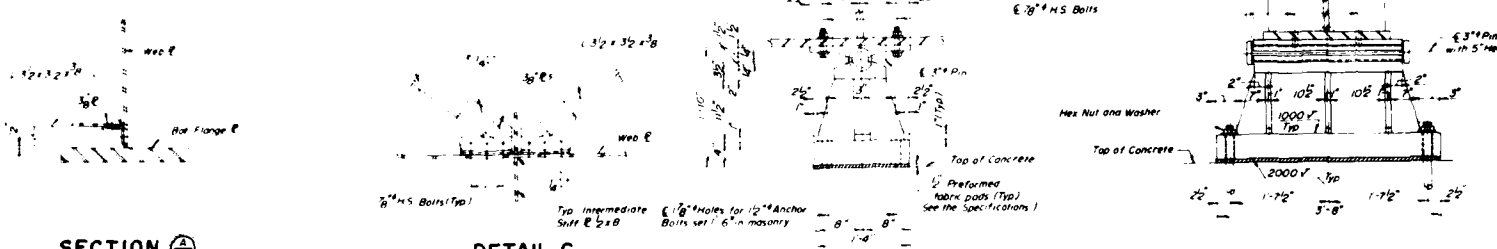
20 10 0 20 40





EXPANSION BEARING

SCALE 1 IN = 1 FT



SECTION A

SCALE 1 IN = 1 FT

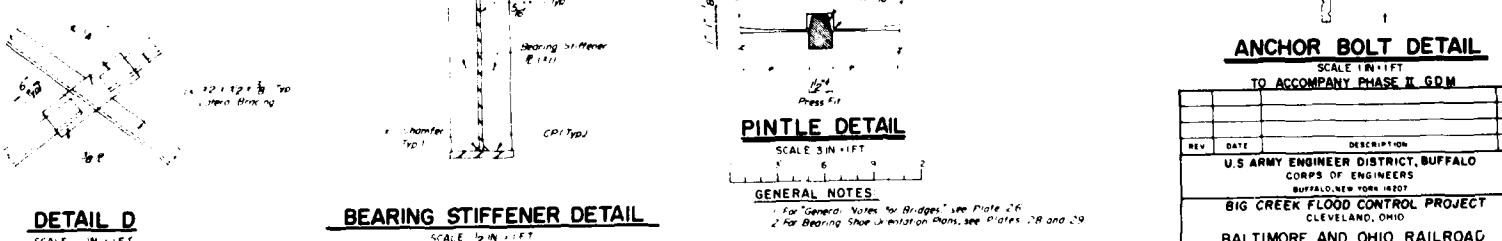
Section A-A Top Lateral Bracing, Top Lateral Bracing similar

DETAIL C

SCALE 1 IN = 1 FT

FIXED BEARING

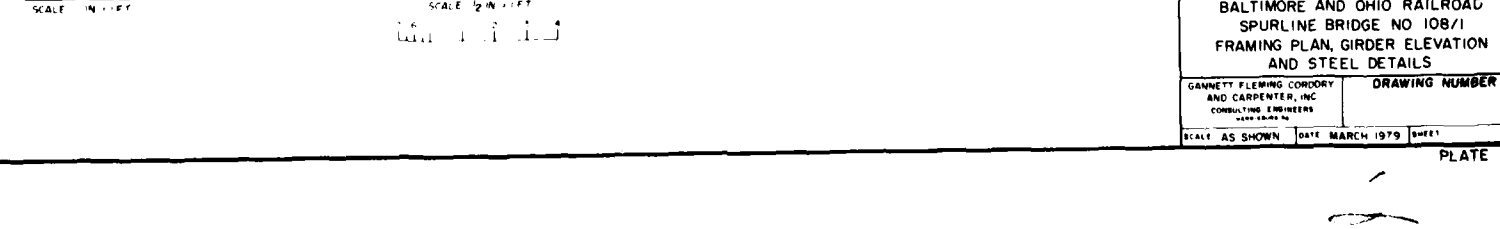
SCALE 1 IN = 1 FT



ANCHOR BOLT DETAIL

SCALE 1 IN = 1 FT

TO ACCOMPANY PHASE II GDM



DETAIL D

SCALE 1 IN = 1 FT

BEARING STIFFENER DETAIL

SCALE ½ IN = 1 FT

PINTLE DETAIL

SCALE 3 IN = 1 FT

GENERAL NOTES

1. For "General Notes for Bridges" see Plate 26.
2. For Bearing Shoe Orientation Plans, see Plates 28 and 29.

REV	DATE	DESCRIPTION	BY

U.S. ARMY ENGINEER DISTRICT, BUFFALO
CORPS OF ENGINEERS
BUFFALO, NEW YORK 14207

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

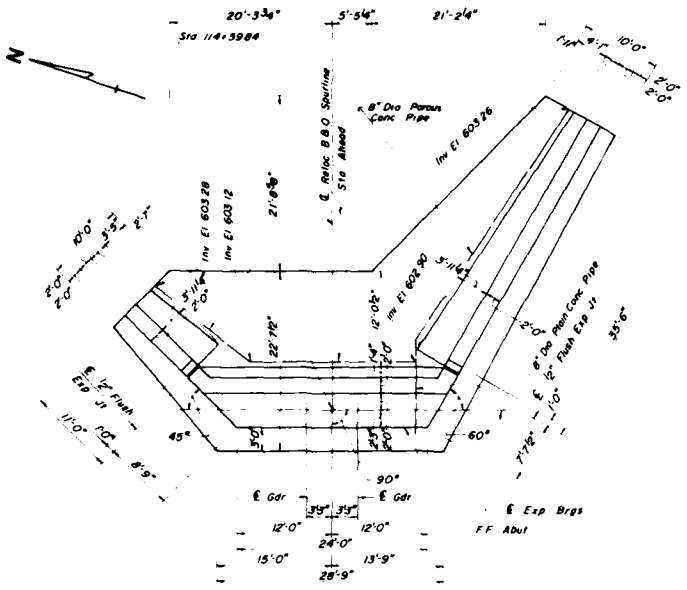
BALTIMORE AND OHIO RAILROAD SPURLINE BRIDGE NO 108/1 FRAMING PLAN, GIRDER ELEVATION AND STEEL DETAILS

GANNETT FLEMING CORDDRY AND CARPENTER, INC
CONSULTING ENGINEERS

DRAWING NUMBER

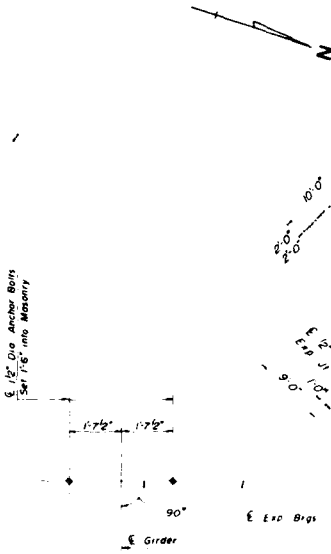
SCALE AS SHOWN | DATE MARCH 1979 | SHEET

PLATE 27



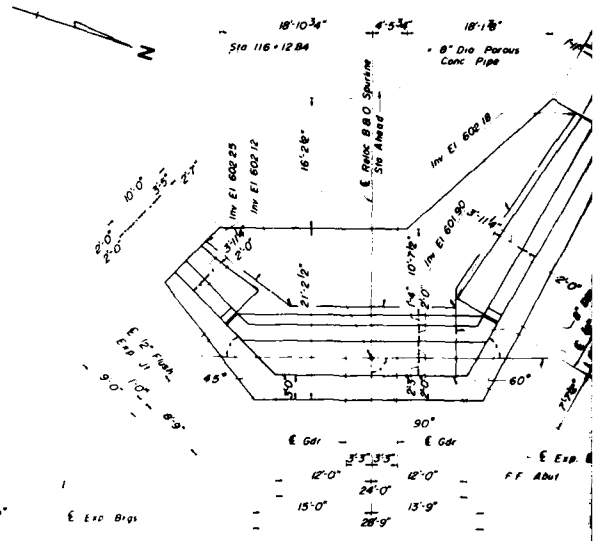
PLAN - ABUTMENT NO. 1

SCALE 1/8 IN = 1 FT



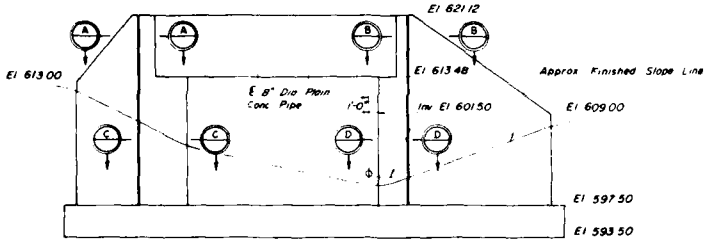
ANCHOR BOLT PLAN

SCALE 1/2 IN = 1 FT



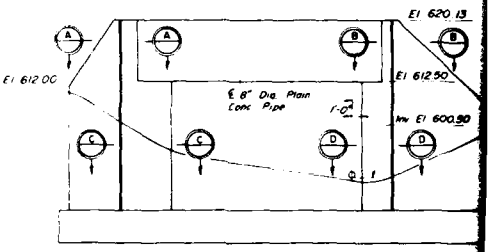
PLAN - ABUTMENT NO. 2

SCALE 1/8 IN = 1 FT



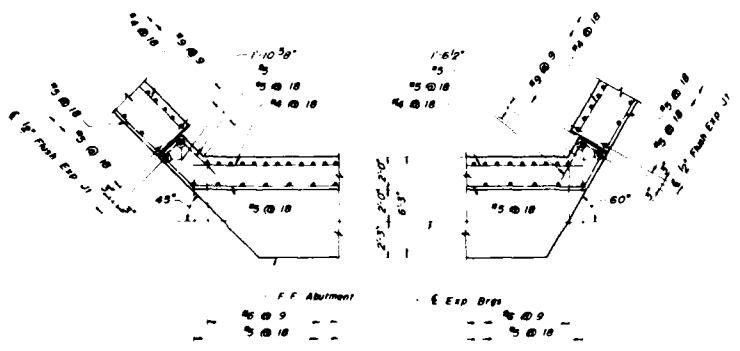
ELEVATION - ABUTMENT NO. 1

SCALE 1/8 IN = 1 FT



ELEVATION - ABUTMENT NO. 2

SCALE 1/8 IN = 1 FT

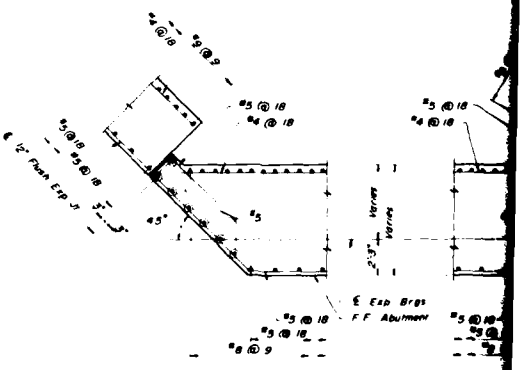


SECTION A

SCALE 1/4 IN = 1 FT

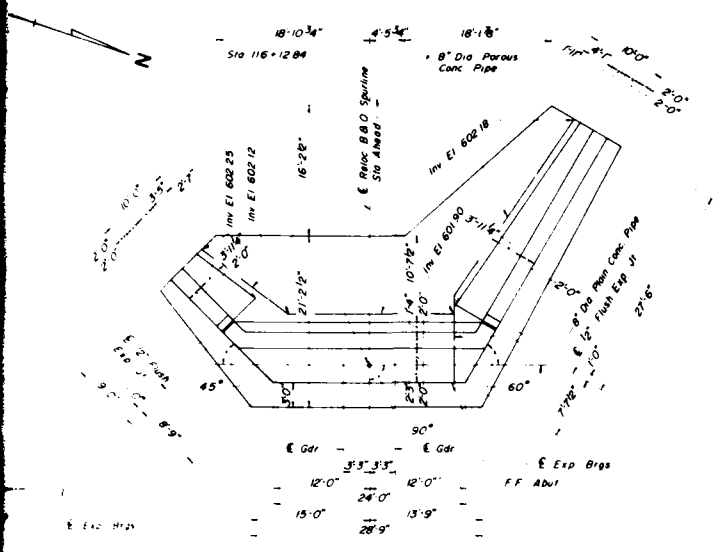
SECTION B

SCALE 1/4 IN = 1 FT



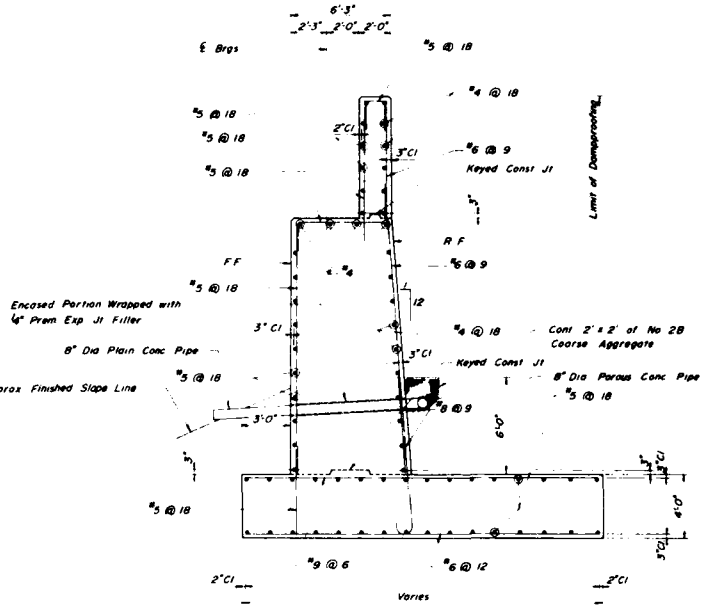
SECTION C

SCALE 1/4 IN = 1 FT



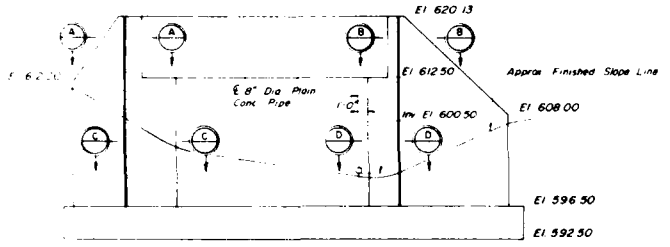
PLAN - ABUTMENT NO. 2

SCALE 1/8 IN = 1 FT



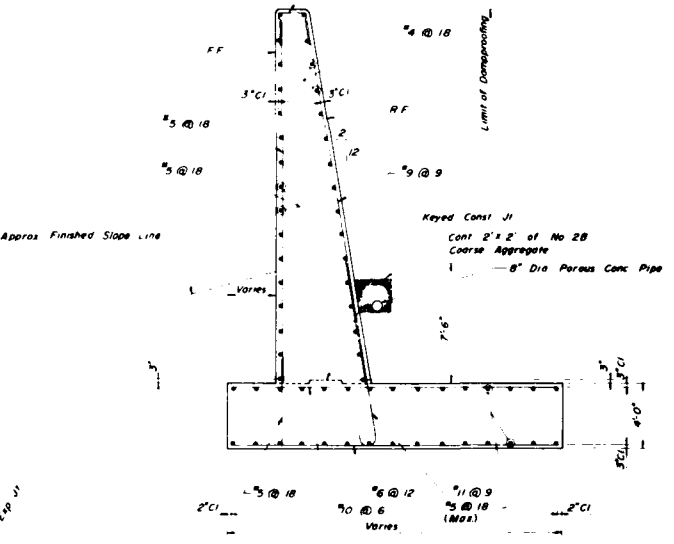
TYPICAL ABUTMENT SECTION

SCALE 1/4 IN = 1 FT



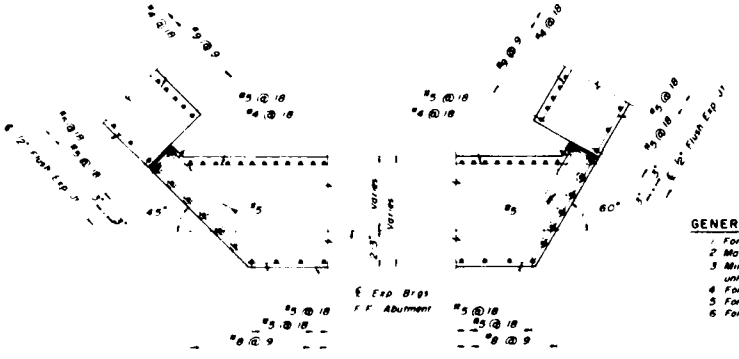
ELEVATION - ABUTMENT NO. 2

SCALE 1/8 IN = 1 FT



TYPICAL WING SECTION

SCALE 1/4 IN = 1 FT



SECTION C

SCALE 1/4 IN = 1 FT

SECTION D

SCALE 1/4 IN = 1 FT

GENERAL NOTES

1. For General Notes, see Plate 26.
2. Maximum Design Foundation Pressure 3.6 Tons/S.F.
3. Minimum reinforcement bar lap splice shall be 30 Diameter unless noted.
4. For Bearing Shoe Details see Plate 21.
5. For Anchor Bolt Details see Plate 21.
6. For Construction and Expansion Joint Details, see Plate 29.

TO ACCOMPANY PHASE II GDM

REV	DATE	DESCRIPTION	BY

U.S ARMY ENGINEER DISTRICT, BUFFALO
CORPS OF ENGINEERS
BUFFALO, NEW YORK 14207

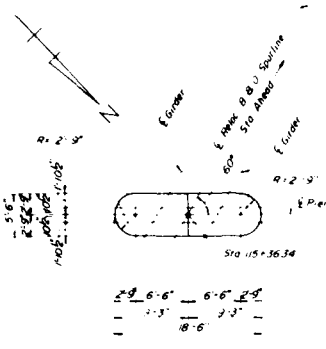
BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

BALTIMORE AND OHIO RAILROAD
SPURLINE BRIDGE NO 108/1

ABUTMENT DETAILS

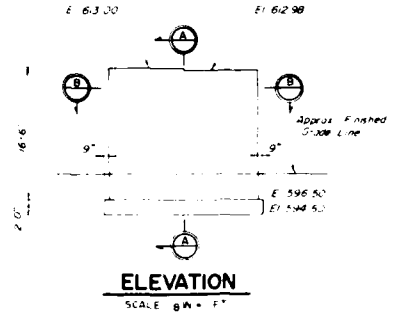
GANNETT FLEMING CORDRY AND CARPENTER, INC CONSULTING ENGINEERS HARRISBURG PA.	DRAWING NUMBER
SCALE AS SHOWN	DATE MARCH 1979 SHEET

PLATE 28



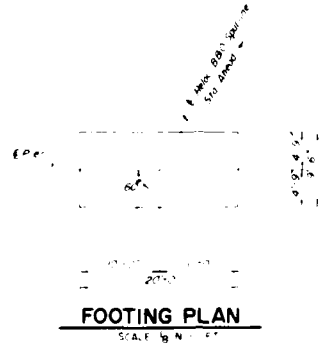
CAP PLAN

SCALE 1/8 IN = 1 FT



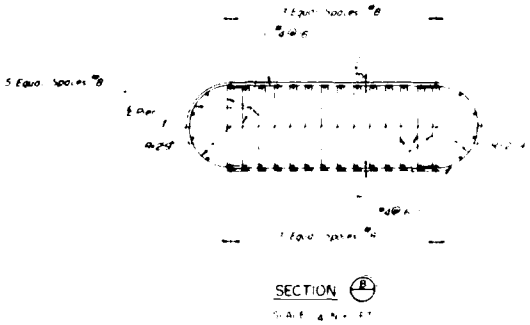
ELEVATION

SCALE 1/8 IN = 1 FT



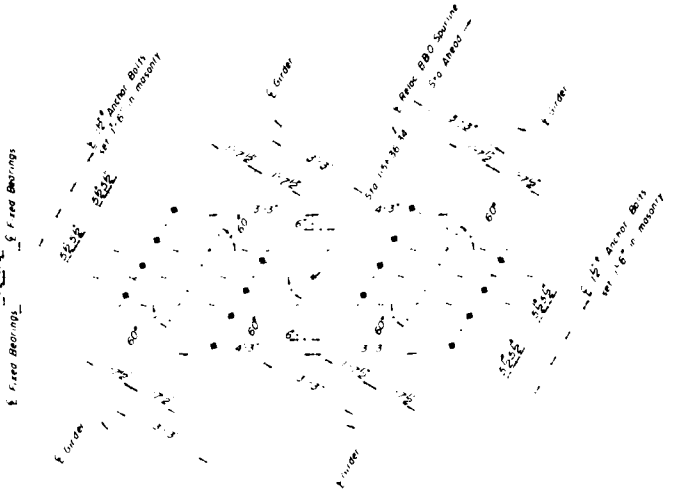
FOOTING PLAN

SCALE 1/8 IN = 1 FT



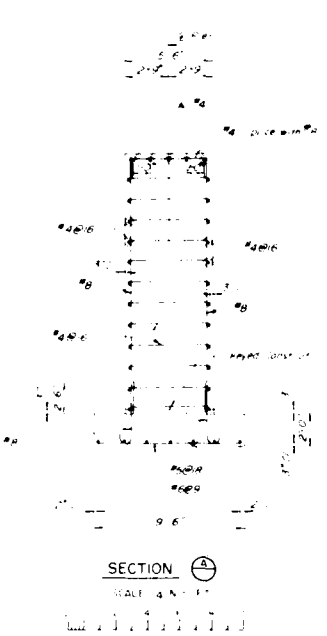
SECTION (B)

SCALE 1/4 IN = 1 FT



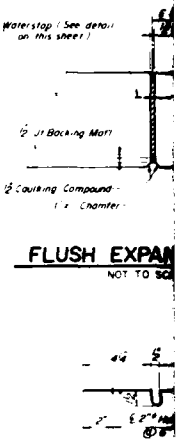
ANCHOR BOLT PLAN

SCALE 1/2 IN = 1 FT



SECTION (A)

SCALE 1/4 IN = 1 FT

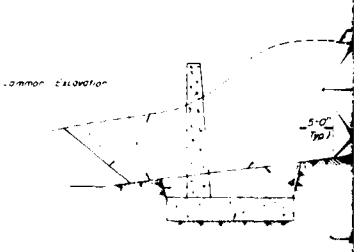


FLUSH EXPAN

NOT TO SC

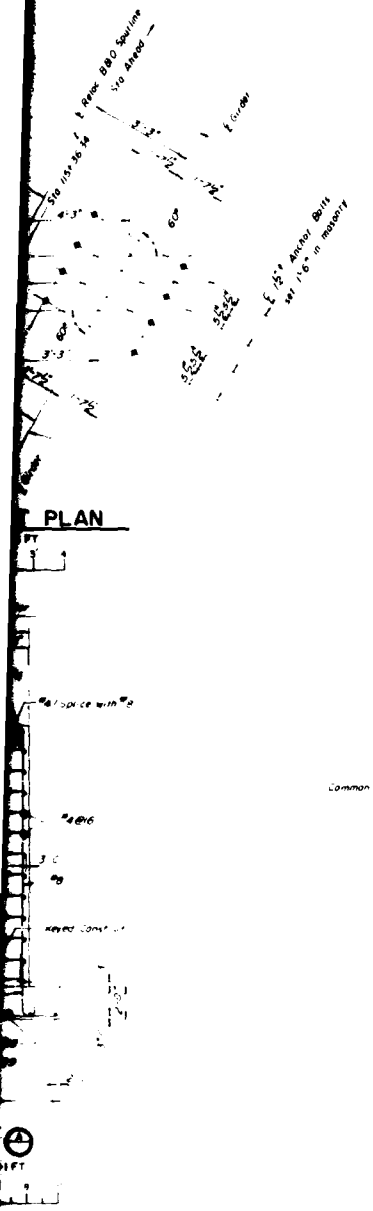
WATERSTOP FOR

NOT TO SC

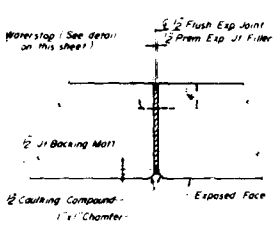


EXCAVATION AT ABUT

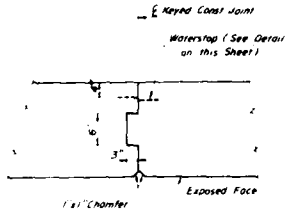
NOT TO SCALE

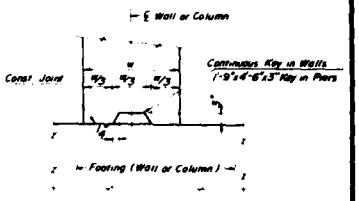


PLAN

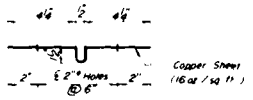


FLUSH EXPANSION JOINT
NOT TO SCALE



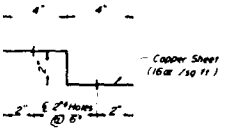


KEYED CONSTRUCTION JOINTS
NOT TO SCALE

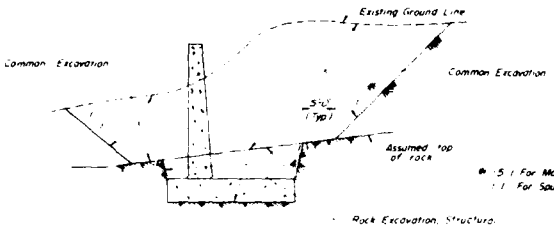


WATERSTOP FOR EXPANSION JOINT
NOT TO SCALE

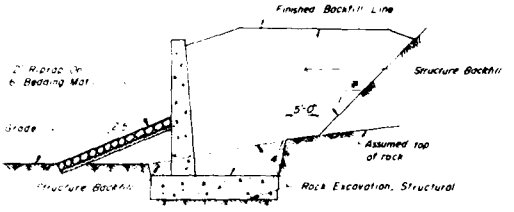
Note
Waterstop shall be stopped one foot from top of wall



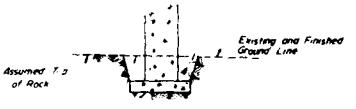
WATERSTOP FOR CONSTRUCTION JOINT
NOT TO SCALE



EXCAVATION AT ABUTMENTS
NOT TO SCALE



BACKFILL AT ABUTMENTS
NOT TO SCALE



EXCAVATION AND BACKFILL AT PIER
NOT TO SCALE

GENERAL NOTES

1. For General Notes see Plate 2A
2. Max Design Foundation Pressure = 4.1 tons / SF
3. Min lap splice shall be 30 diameters, unless noted
4. For Shoe details, see Plate 2
5. For anchor bolt details see Plate 2

TO ACCOMPANY PHASE II GDM

REV	DATE	DESCRIPTION	BY

U.S. ARMY ENGINEER DISTRICT, BUFFALO
CORPS OF ENGINEERS
BUFFALO, NEW YORK 14207

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

BALTIMORE AND OHIO RAILROAD
SPURLINE BRIDGE NO 108/1
PIER DETAILS

GANNETT FLEMING CORDDRY AND CARPENTER, INC
CONSULTING ENGINEERS
HARRISBURG PA

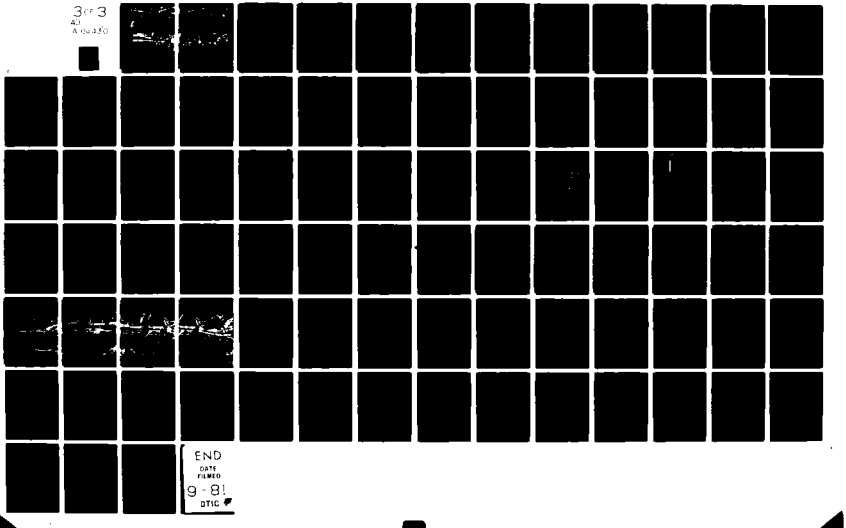
DRAWING NUMBER

SCALE AS SHOWN | DATE MARCH 1979 | SHEET

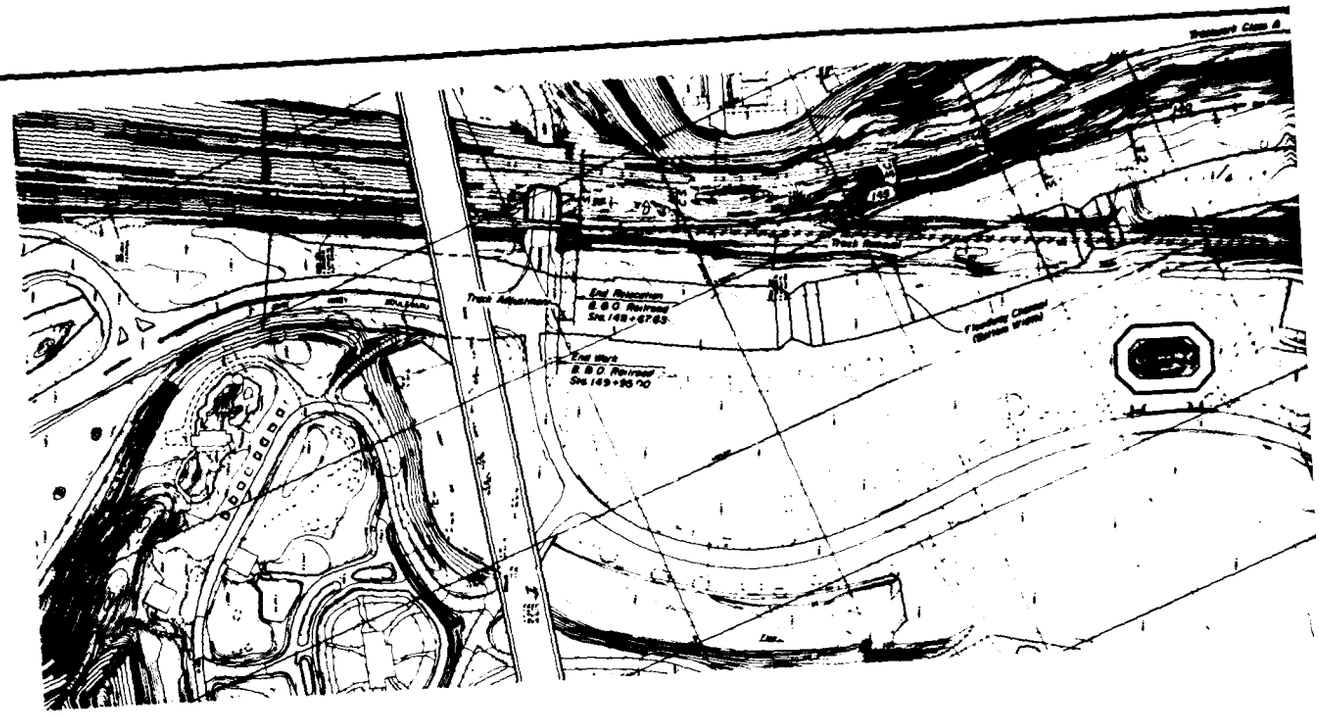
PLATE 2

AD-A102 430 CORPS OF ENGINEERS BUFFALO NY BUFFALO DISTRICT F/G 13/2
BIG CREEK FLOOD CONTROL PROJECT, CLEVELAND, OHIO. PHASE II. GEN--ETC(U)
AUG 79

UNCLASSIFIED NL

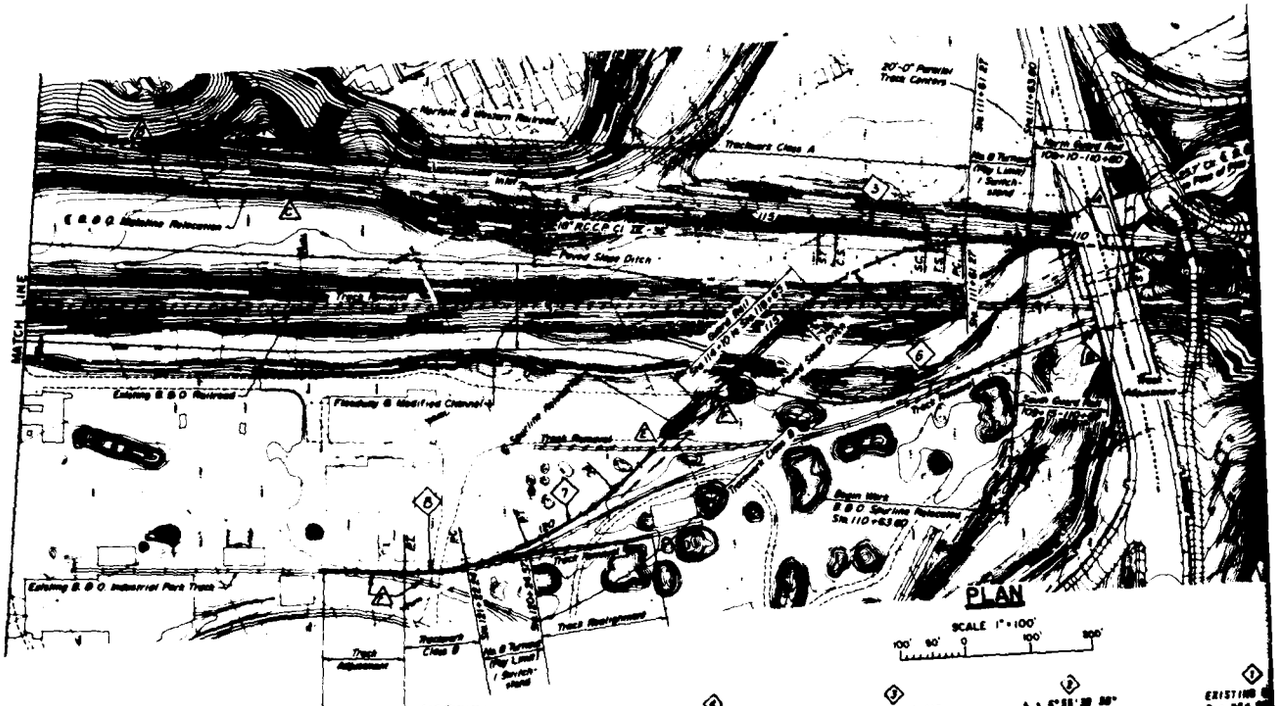


END
DATE FILMED
9-81
DTIC



RECOMMENDED STAGE CONSTRUCTION

1. CONSTRUCT NORFOLK AND WESTERN TRESTLE BENTS (SEE STAGE OF CONSTRUCTION ON BRIDGE PLAN)
2. CONSTRUCT B & O MAINLINE BRIDGE DURING THIS TIME. ACCOMPLISH EXCAVATION TO ALLOW FOR PLACEMENT OF FILL. PLACE MAINLINE EMBANKMENT WHERE POSSIBLE
3. COMPLETE ALL PLACEMENT OF EMBANKMENT FOR B & O MAINLINE. COMPLETE PLACEMENT OF TRACKAGE FOR B & O MAINLINE, BETWEEN STA 104+00 AND STA 147+00 INCLUDING TEMPORARY TURNOUT AND TEMPORARY TRACKAGE FOR CONNECTION TO INDUSTRIAL PARK
4. COMPLETE CONNECTIONS TO EXISTING MAINLINE STA 100+80± TO STA 104+00 AND STA 147+00 TO STA 149+70. SHIFT TRAFFIC TO RELOCATED B & O MAINLINE AND REMOVE TEMPORARY SPUR CONNECTION
5. CONSTRUCT BRIDGE TO INDUSTRIAL PARK AND PLACE EMBANKMENT FOR SPUR LINE
6. UPON COMPLETION OF INDUSTRIAL PARK BRIDGE CONSTRUCT SPUR LINE TRACKAGE AND ADJUST ES EXISTING TRACKAGE WITHIN THE INDUSTRIAL PARK
7. SHIFT INDUSTRIAL PARK TRAFFIC TO NEW SPUR LINE AND REMOVE TEMPORARY TURNOUT AND TEMPORARY CONNECTION TRACKAGE



6
Δ = 13°59'59 46"
R = 409 26'
D = 14°00'00"
Lc = 100 00'
E = 0
P C STA 139+99 54
P T STA 140+99 54

7
Δ = 88°46'11 05"
R = 409 26
D = 14°00'00"
Lc = 168 64'
E = 0
P C STA 118+59 60
P T STA 120+28 24

8
Δ = 41°09 35 48
R = 409 26
D = 14°00'00"
Lc = 293 98
E = 0
P C STA 111+63 60
P T STA 114+57 58

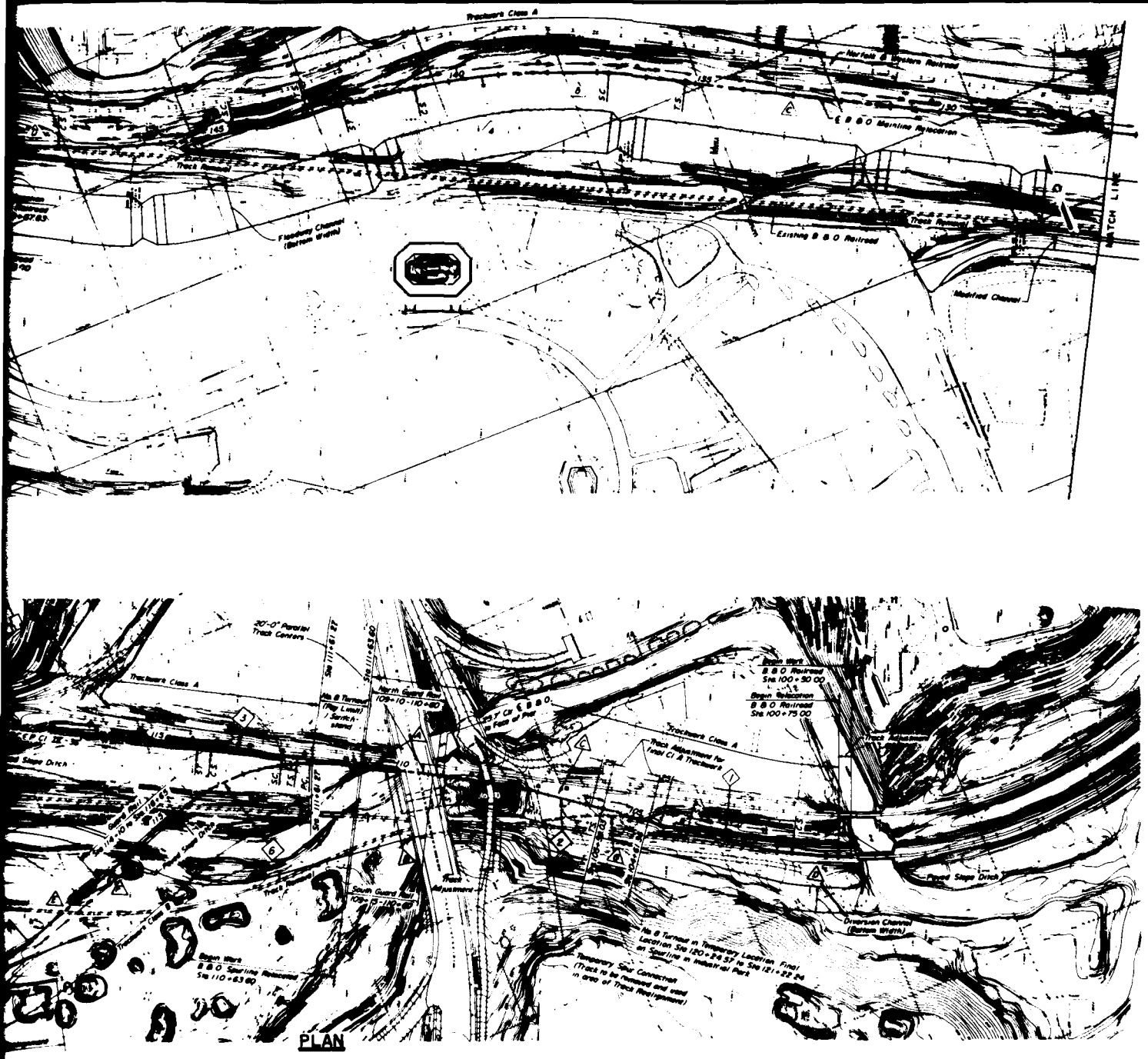
9
Δ = 20°48 49 35"
R = 1433 00'
D = 4°00 00"
Lc = 365 56'
Ls = 155 00
E = 2 1/8"
THROW = 0 70' (OFFSET)
T S STA 142+92 26
S C STA 144+47 96
C S STA 148+18 83
S T STA 149+67 83

6
Δ = 21°54'38 77"
R = 1433 00'
D = 4°00'00"
Lc = 393 00'
Ls = 155 00'
E = 2 1/8"
THROW = 0 70' (OFFSET)
T S STA 138+80 85
S C STA 136+76 85
C S STA 140+68 85
S T STA 142+23 25

7
Δ = 1°46'41 41"
R = 5730 00'
D = 1°00'00"
Lc = 146 83'
Ls = 31 00'
E = 1/8"
THROW = 0 007' (OFFSET)
T S STA 111+90 80
S C STA 112+19 80
C S STA 113+66 43
S T STA 113+97 43

8
Δ = 6°58'39 88"
R = 1433 00'
D = 4°00'00"
Lc = 18 86'
Ls = 155 00'
E = 2 1/8"
THROW = 0 70' (OFFSET)
T S STA 105+88 03
S C STA 107+14 03
C S STA 107+32 89
S T STA 108+07 89

9
EXISTING
R = 954.
Lc = 217.
LT = 140.
ST = 78.
E = 3 1/8"
THROW = 0.
C S STA.
S T STA.



PLAN

SCALE 1" = 100'

④	③	②	①
Δ = 21°56' 38 77"	Δ = 1°45' 41 41"	Δ = 6°55' 38 88"	EXISTING 6°00' 00"
R = 1433 00	R = 5730 00'	R = 1433 00'	R = 954 93'
D = 4°00' 00"	D = 1°00' 00"	D = 4°00' 00"	Ls = 217 00'
Lc = 393 00	Lc = 146 83'	Lc = 18 26'	LT = 144 76'
Ls = 155 00	Ls = 31 00'	Ls = 155 00'	ST = 78 42'
E = 2 1 3"	E = 1 1 2"	E = 2 1 2"	E = 3 1/2" OR MATCH EXISTING
THROW = 0 70' (OFFSET)	THROW = 0 007' (OFFSET)	THROW = 0 70' (OFFSET)	THROW = 2 054' (OFFSET)
T S STA 139+80 25	T S STA 111+08 60	T S STA 105+89 03	C S STA 101+65 50
S C STA 136+75 25	S C STA 112+19 60	S C STA 107+14 03	S T STA 103+82 50
C S STA 140+68 25	C S STA 113+66 43	C S STA 107+32 29	
S T STA 142+23 25	S T STA 113+97 43	S T STA 108+87 29	

LEGEND

- Track Removal
- Permanent Trackage
- Temporary Trackage
- Ditch (1' Deep Below Subgrade)
- Paved Slope Ditch
- A — B & O Communication Pole (8'-6" Min. Clr. to ℄ Trk.)
- B — N & W Communication Pole (8'-6" Min. Clr. to ℄ Trk.)

GENERAL NOTES

1. All Track and Turnout Construction to be in accordance with B & O Standards
2. All Mainline Trackage to be continuous Welded Rail
3. All Spurline Temporary Trackage to be Bolted Construction

TO ACCOMPANY PHASE II EIS

REV	DATE	DESCRIPTION

U.S. ARMY ENGINEER DISTRICT, BUFFALO
CORPS OF ENGINEERS
BUFFALO, NEW YORK 14207

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

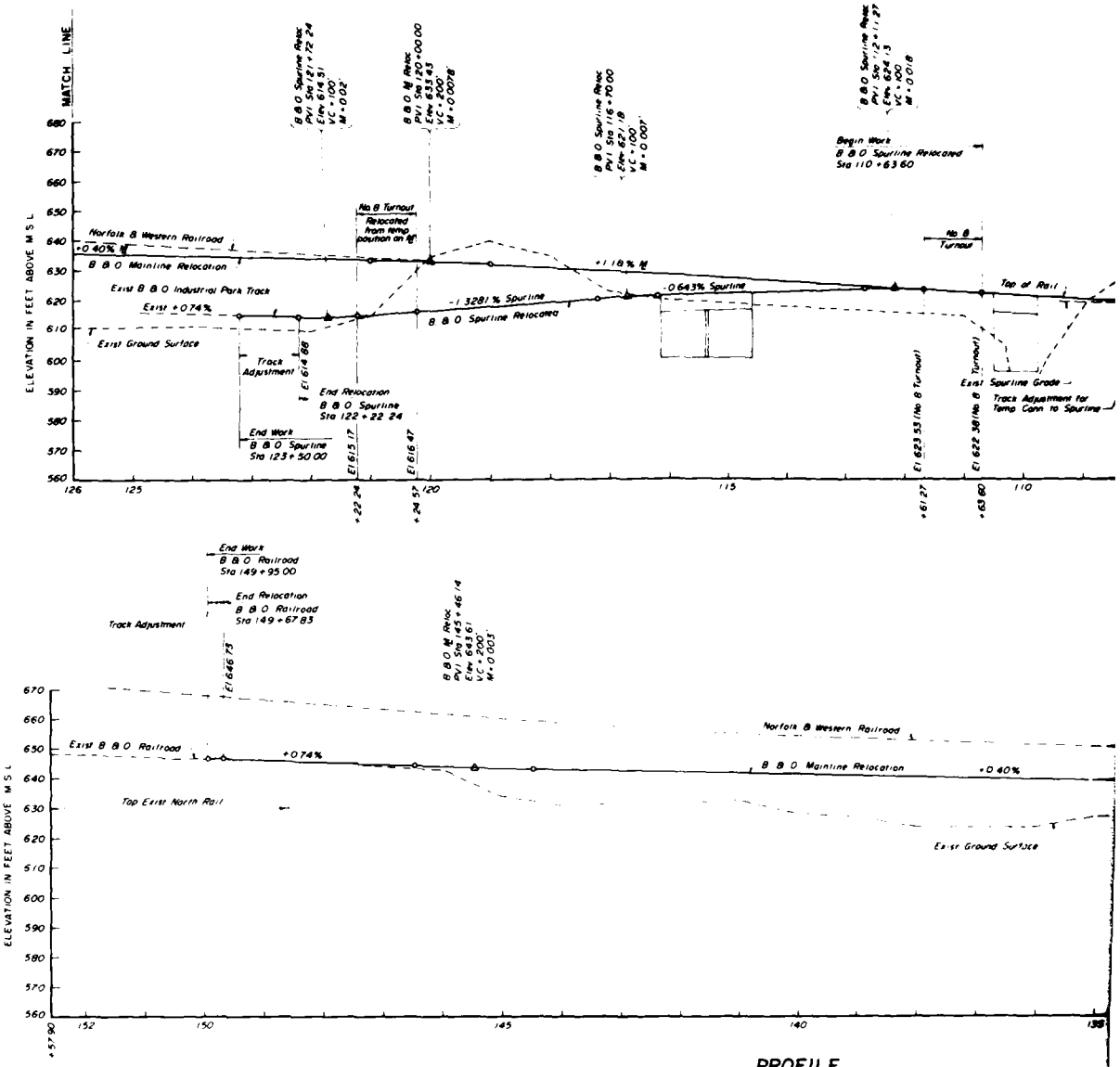
BALTIMORE AND OHIO RAILROAD RELOCATED MAINLINE AND SPURLI PLAN AND STAGE CONSTRUCTION

GARNETT FLEMING CORDRY AND CARPENTER, INC.
CONSULTING ENGINEERS
HARRISBURG, PA.

DRAWING NUMBER

SCALE: AS SHOWN | DATE: MARCH 1979 | SHEET

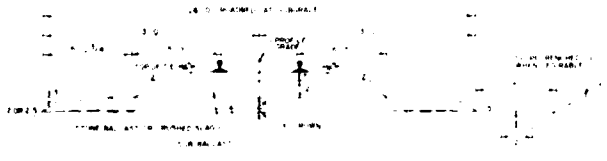
PLATE



PROFILE

HORIZONTAL SCALE 1" = 100'

VERTICAL SCALE 1" = 20'

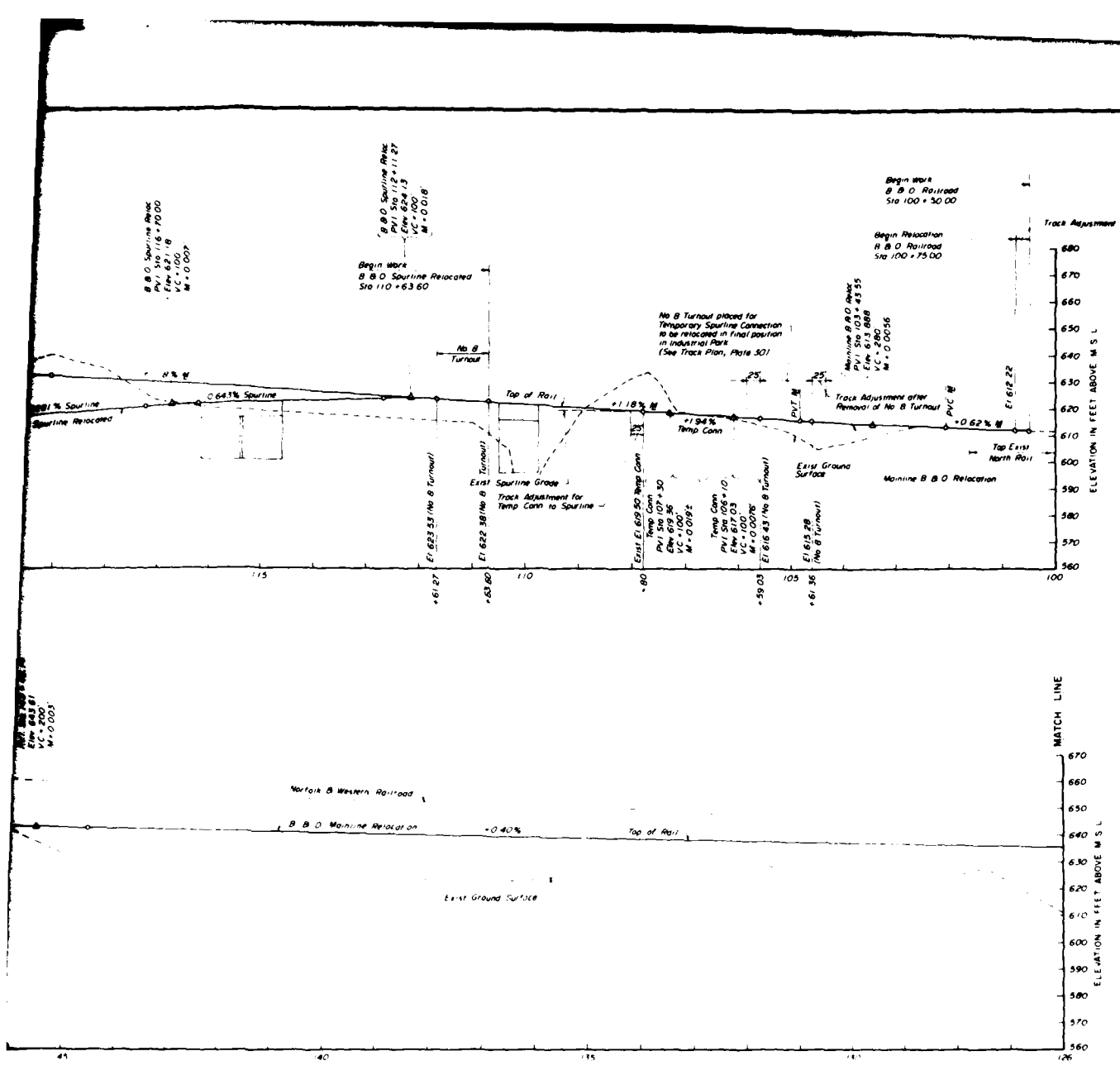


CLASS A TRACK TANGENT AND CURVES HAVING 2° OR LESS ELEVATION

CLASS A TRACK CURVES HAVING OVER 2° ELEVATION

ROADBED AND BALLAST SECTIONS FOR NEW CONSTRUCTION

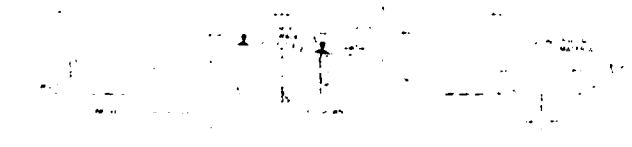
NOT TO SCALE



PROFILE

HORIZONTAL SCALE 1" = 100'

VERTICAL SCALE 1" = 20'



ROADBED AND BALLAST SECTIONS FOR NEW CONSTRUCTION

CLASS B TRACK TANGENT AS BUILT

BALLAST SECTION BETWEEN TRACKS

NOTES

Roadbed and Ballast Sections shown are for use in Track Construction with Jointed Rail and Welded Rail. Stone or Slag Ballast will be laid level with top of Tie, extending level 6" beyond Tie End and sloping off at not greater than a 1V on 2H Slope to the Sub Ballast

CLASS "A" TRACK

Tangent & Curves having 2" or less Elevation

On Curves up to 2" elevation and on on Sub Ballast Section as shown and maintain 12" Stone Ballast or Crushed Slag under the low Rail Where necessary Ballast Section should be widened slightly on the high side of Curve to hold Slope to not greater than 1V on 2H

Curves having over 2" Elevation

Curves over 2" elevation, surface of Sub Ballast Section is to be sloped at 1" in 20" as shown Balance of elevation is to be carried by increasing Ballast Section, minimum of 12" Ballast must be maintained under low Rail

TO ACCOMPANY PHASE II GDM

NO	DATE	DESCRIPTION

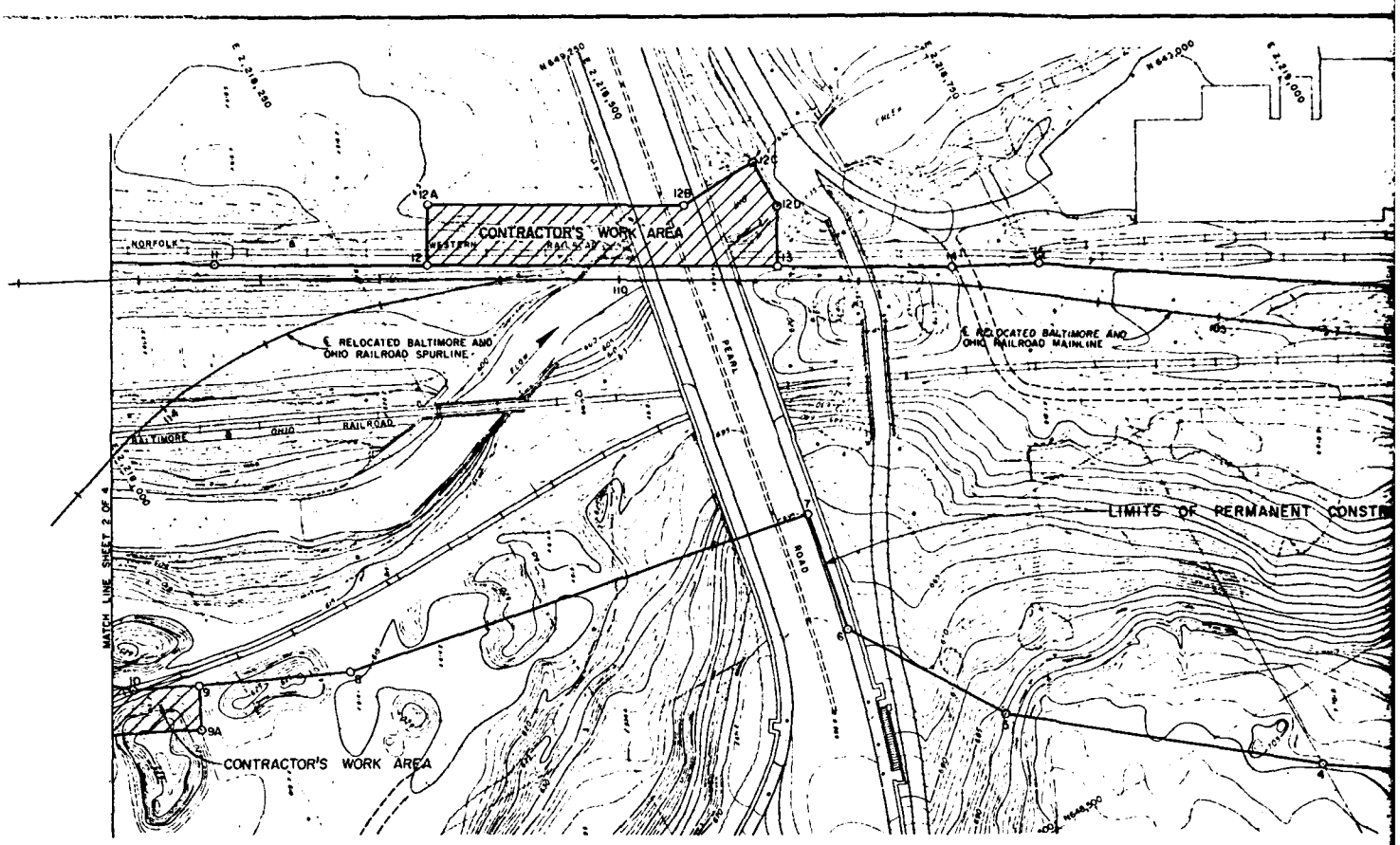
U S ARMY ENGINEER DISTRICT, BUFFALO
CORPS OF ENGINEERS
BUFFALO, NEW YORK 14207

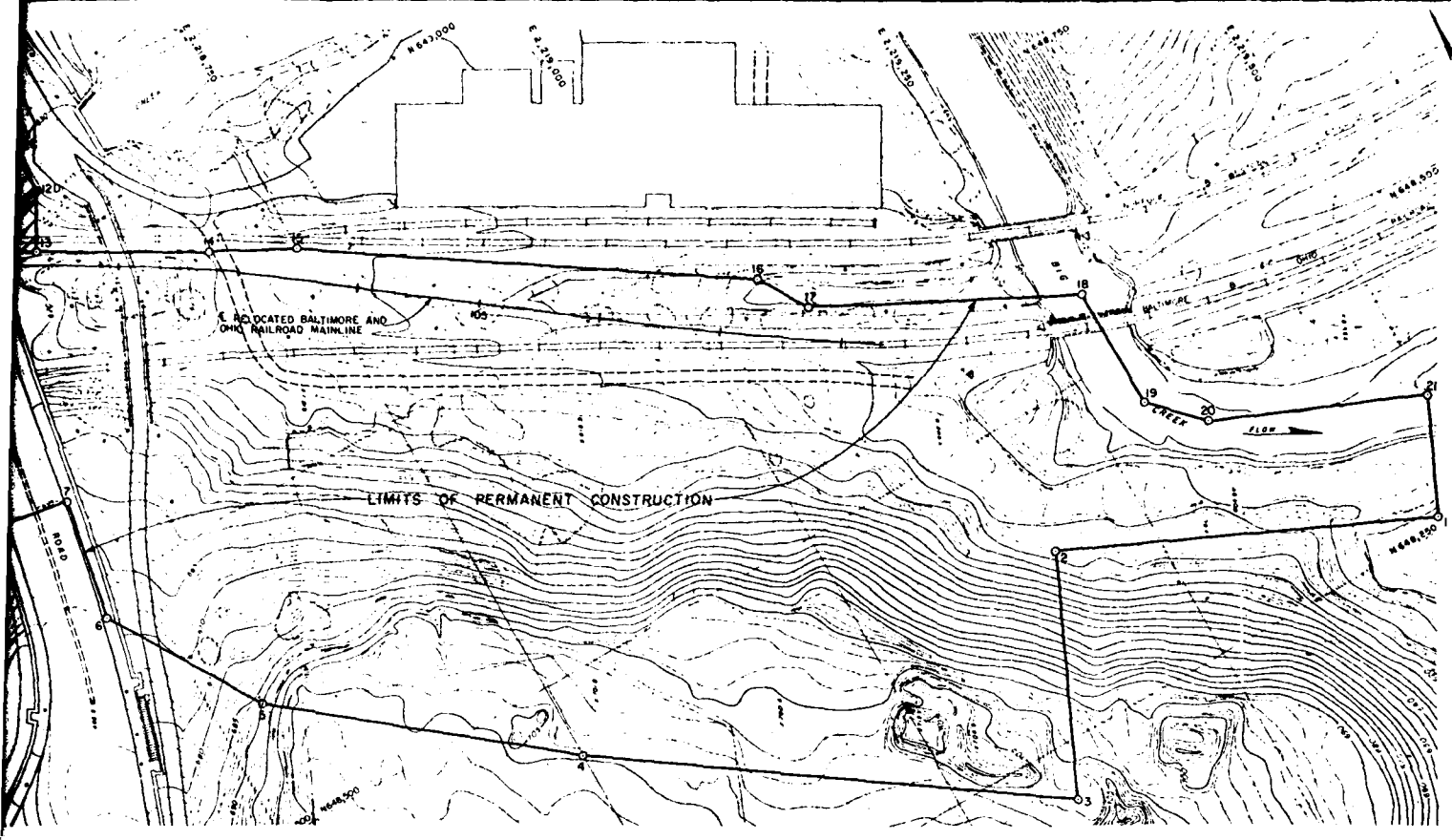
BIG CREEK FLOOD CONTROL PROJ
CLEVELAND, OHIO

BALTIMORE AND OHIO RAILRO
RELOCATED MAINLINE AND SP
PROFILE AND TYPICAL ROADBED S

SANNETT FLEMING CORDDRY AND CARPENTER, INC CONSULTING ENGINEERS	DRAWING N
SCALE AS SHOWN	DATE MARCH 1979

SHEET


CONTRACTOR'S WORK AREA
℄ RELOCATED BALTIMORE AND OHIO RAILROAD SPURLINE
℄ RELOCATED BALTIMORE AND OHIO RAILROAD MAINLINE
NORFOLK & WESTERN RAILROAD
BALTIMORE & OHIO RAILROAD
PEARL ROAD
LIMITS OF PERMANENT CONSTR
MATCH LINE SHEET 2 OF 4
CONTRACTOR'S WORK AREA



COORDINATES

POINT NO.	COORDINATES		POINT NO.	COORDINATES	
	NORTH	EAST		NORTH	EAST
1	648,260	2,219,459	12A	649,205	2,218,331
2	648,391	2,219,170	12B	649,099	2,218,516
3	648,205	2,219,086	12C	649,101	2,218,583
4	648,437	2,218,750	12D	649,061	2,218,583
5	648,602	2,218,540	13	649,017	2,218,558
6	648,729	2,218,461	14	648,944	2,218,685
7	648,828	2,218,480	15	648,911	2,218,750
8	648,902	2,218,083	16	648,705	2,219,065
9	648,956	2,217,967	17	648,664	2,219,092
9A	648,923	2,217,952	18	648,560	2,219,292
10	648,979	2,217,919	19	648,458	2,219,295
11	649,250	2,218,151	20	648,420	2,219,333
12	649,162	2,218,309	21	648,351	2,219,500

REAL ESTATE REQUIREMENT

NO.	DATE	DESCRIPTION

U.S. ARMY ENGINEER DISTRICT, BUFFALO
CORPS OF ENGINEERS
BUFFALO, NEW YORK 14207

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

LIMITS OF PROPERTY ACQUISITI
SHEET 1 OF 4

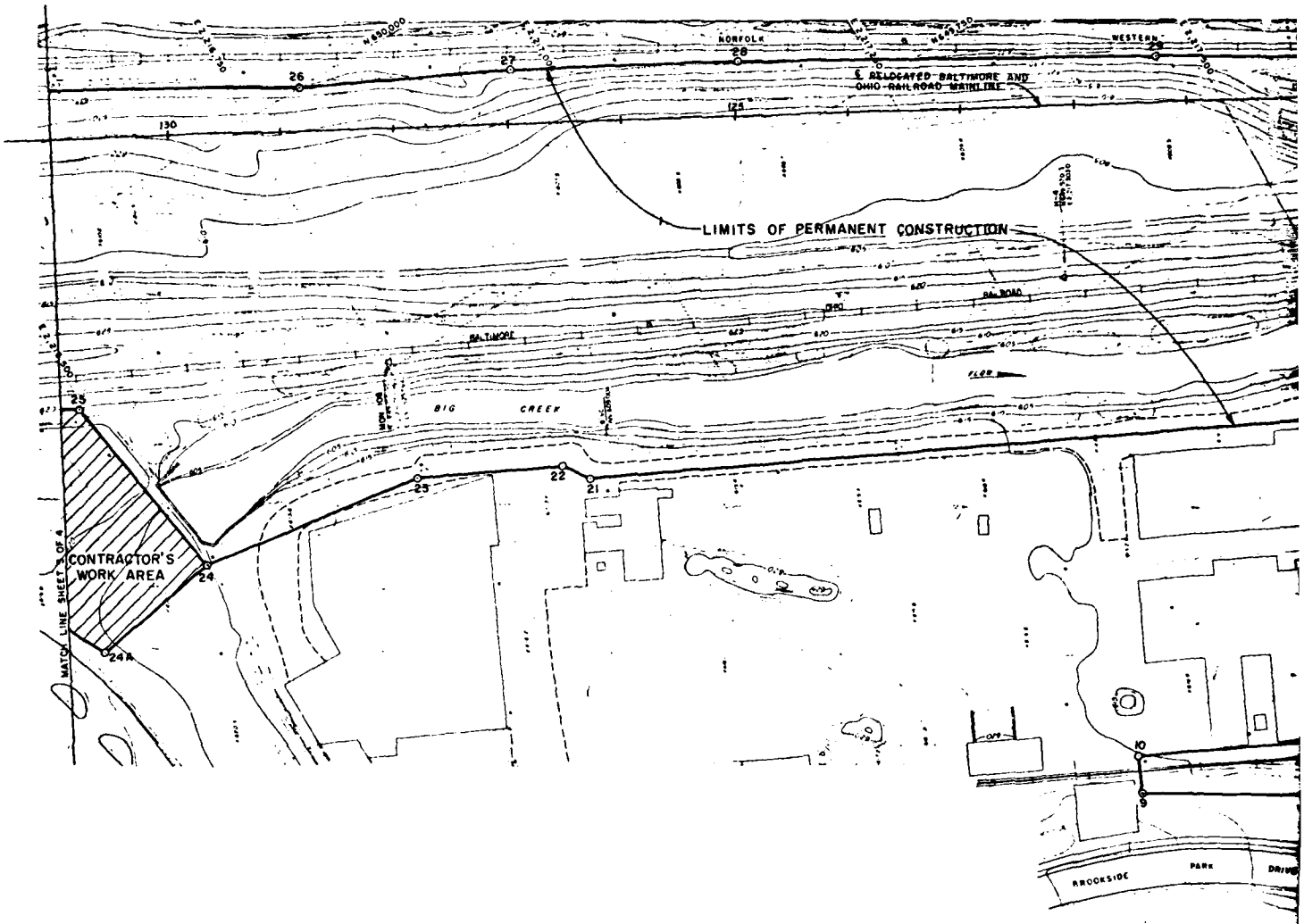
DAMETT FLEMING GOODRICH AND CARPENTER, INC.
CONSULTING ENGINEERS
CLEVELAND, OHIO

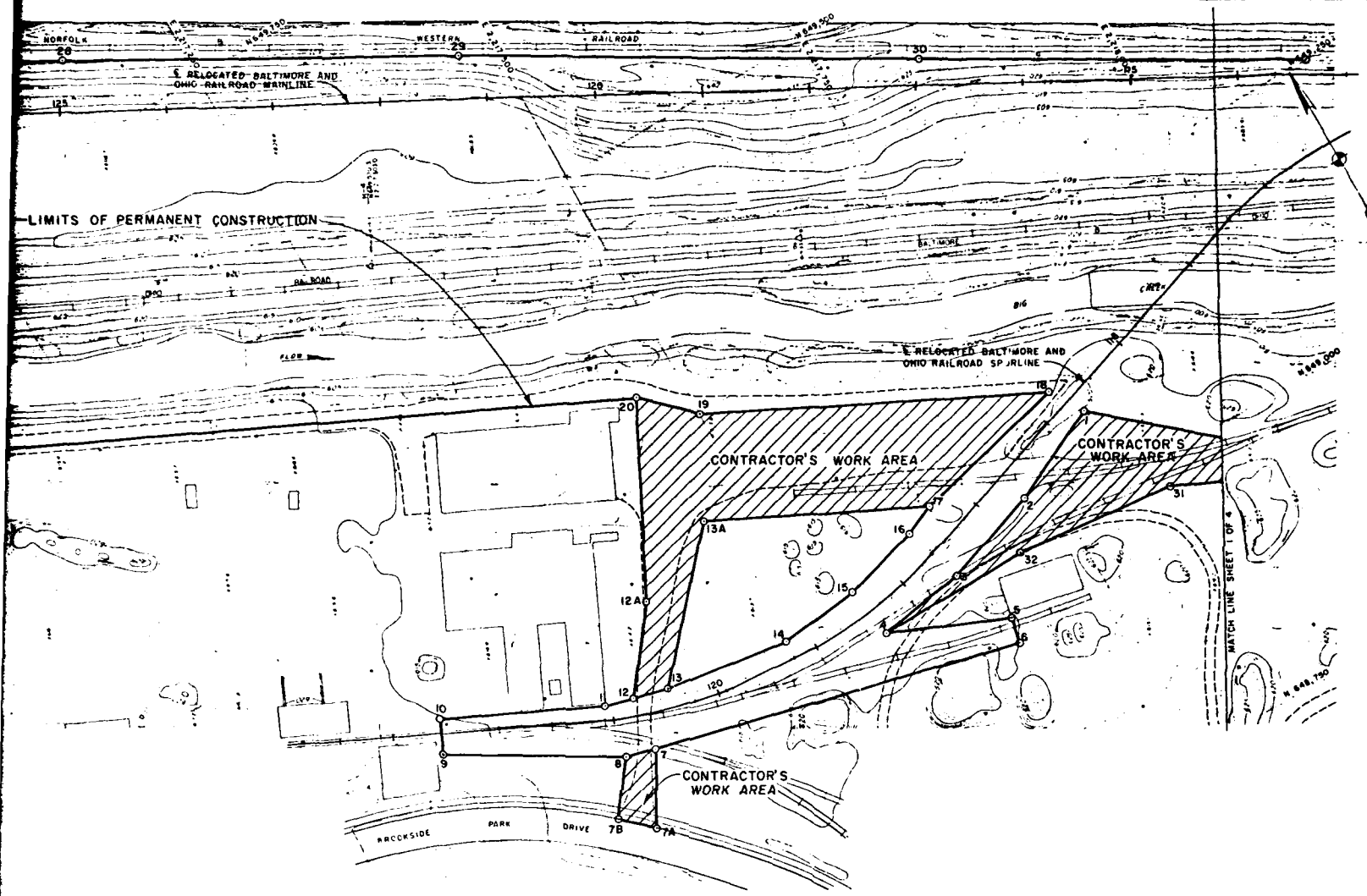
DRAWING NUMBER

SCALE: 1 IN. = 60 FT. DATE: JAN. 18, 1979 SHEET

TO ACCOMPANY PHASE II GDM

PLATE 32


LIMITS OF PERMANENT CONSTRUCTION
CONTRACTOR'S WORK AREA
MATCH LINE SHEET 3 OF 4
BIG CREEK
RAILROAD
BALTIMORE
NORFOLK
WESTERN
RELOCATED BALTIMORE AND OHIO RAILROAD MAIN LINE
BROOKSIDE
PARK
FLOW
25
24
24A
23
22
21
27
28
26
130
125



COORDINATES

POINT NO.	COORDINATES NORTH	COORDINATES EAST	POINT NO.	COORDINATES NORTH	COORDINATES EAST
1	649,074	2,217,811	15	649,037	2,217,542
2	649,031	2,217,724	16	649,057	2,217,615
3	649,002	2,217,634	17	649,069	2,217,644
4	648,988	2,217,550	18	649,105	2,217,792
5	648,942	2,217,658	19	649,250	2,217,500
6	648,918	2,217,653	20	649,292	2,217,457
7	649,003	2,217,310	21	649,579	2,216,854
7A	648,939	2,217,276	22	649,601	2,216,839
7B	648,964	2,217,248	23	649,656	2,216,723
8	649,012	2,217,283	24	649,682	2,216,526
9	649,098	2,217,137	24A	649,662	2,216,409
10	649,128	2,217,151	25	649,858	2,216,497
11	649,062	2,217,290	26	650,000	2 216 806
12	649,055	2,217,316	27	649,922	2,216,972
12A	649,126	2,217,370	28	649,827	2,217,149
13	649,047	2,217,348	29	649,645	2,217,470
13A	649,164	2,217,455	30	649,430	2,217,841
14	649,029	2,217,466	31	648,974	2,217,846
			32	648,990	2,217,695

REAL ESTATE REQUIREMEN

REV	DATE	DESCRIPTION

U.S. ARMY ENGINEER DISTRICT, BUFFALO
CORPS OF ENGINEERS
BUFFALO, NEW YORK 14207

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

LIMITS OF PROPERTY ACQUISITI
SHEET 2 OF 4

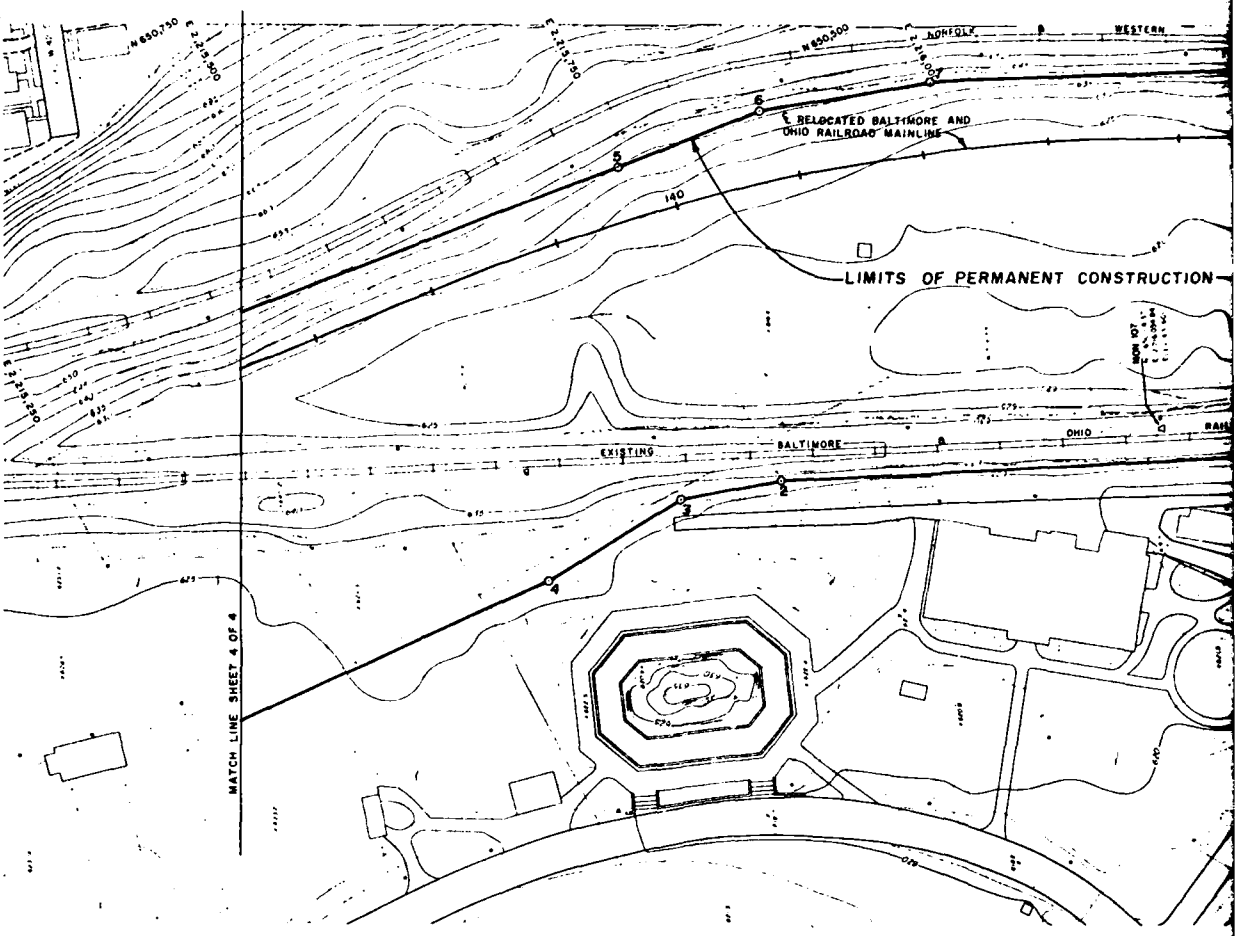
BANNETT FLEMING CORDRY AND CARPENTER, INC.
CONSULTING ENGINEERS

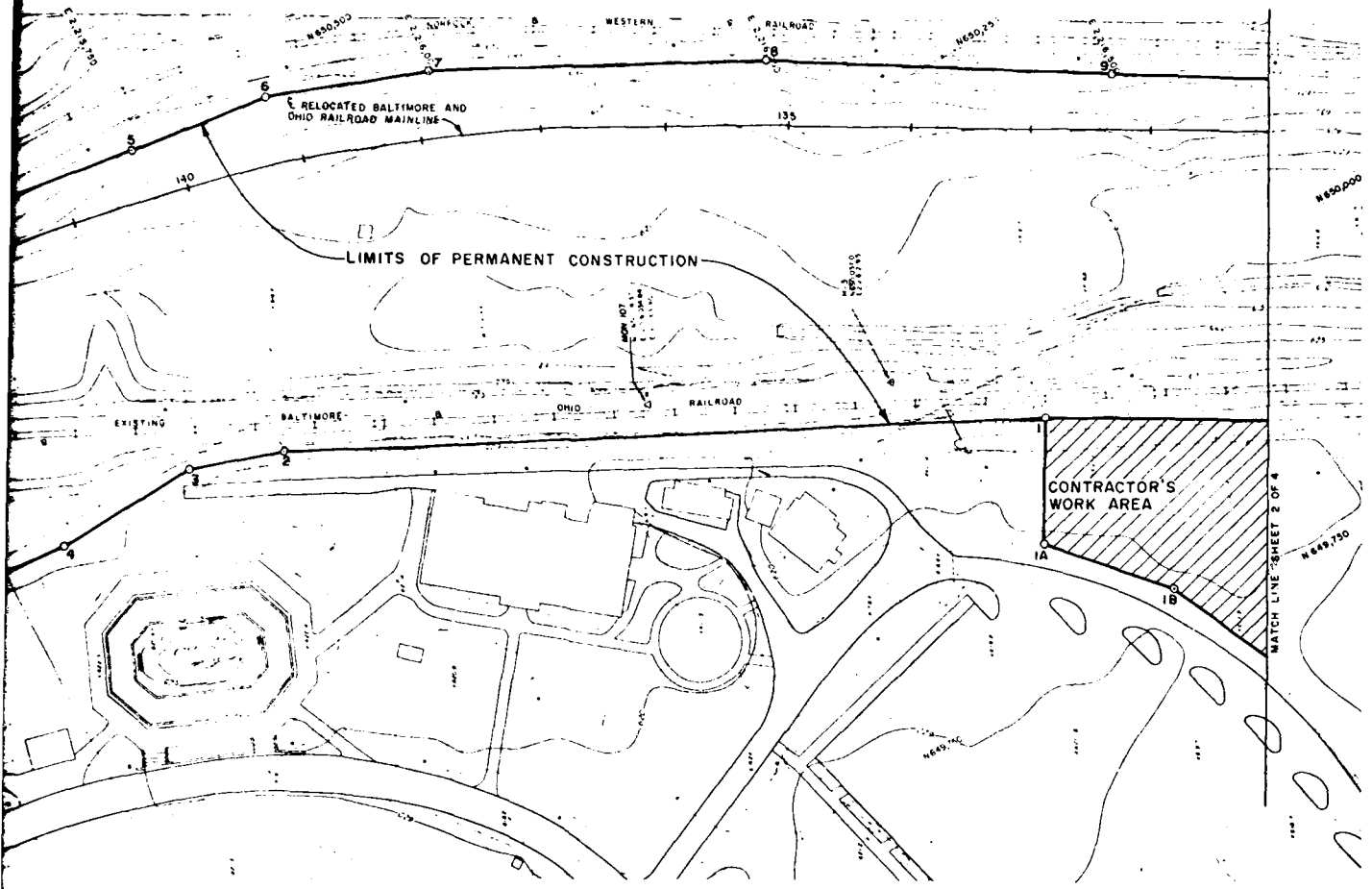
DRAWING NUM

SCALE 1 IN. = 80 FT | DATE: JAN 12, 1979 | SHEET:

TO ACCOMPANY PHASE II GDM

PLATE


N 850,500
E 2,215,700
℄ RELOCATED BALTIMORE AND OHIO RAILROAD MAINLINE
LIMITS OF PERMANENT CONSTRUCTION
EXISTING
BALTIMORE
OHIO
MATCH LINE SHEET 4 OF 4
140



COORDINATES

POINT NO.	COORDINATES	
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1B	649,779	2,216,352
2	650,218	2,215,750
3	650,243	2,215,675
4	650,235	2,215,553
5	650,494	2,215,750
6	650,479	2,215,868
7	650,437	2,216,000
8	650,316	2,216,250
9	650,172	2,216,500

REAL ESTATE REQUIREM

REV	DATE	DESCRIPTION

U.S. ARMY ENGINEER DISTRICT, BUFFA
CORPS OF ENGINEERS
BUFFALO, NEW YORK 14207

BIG CREEK FLOOD CONTROL PROJ
CLEVELAND, OHIO

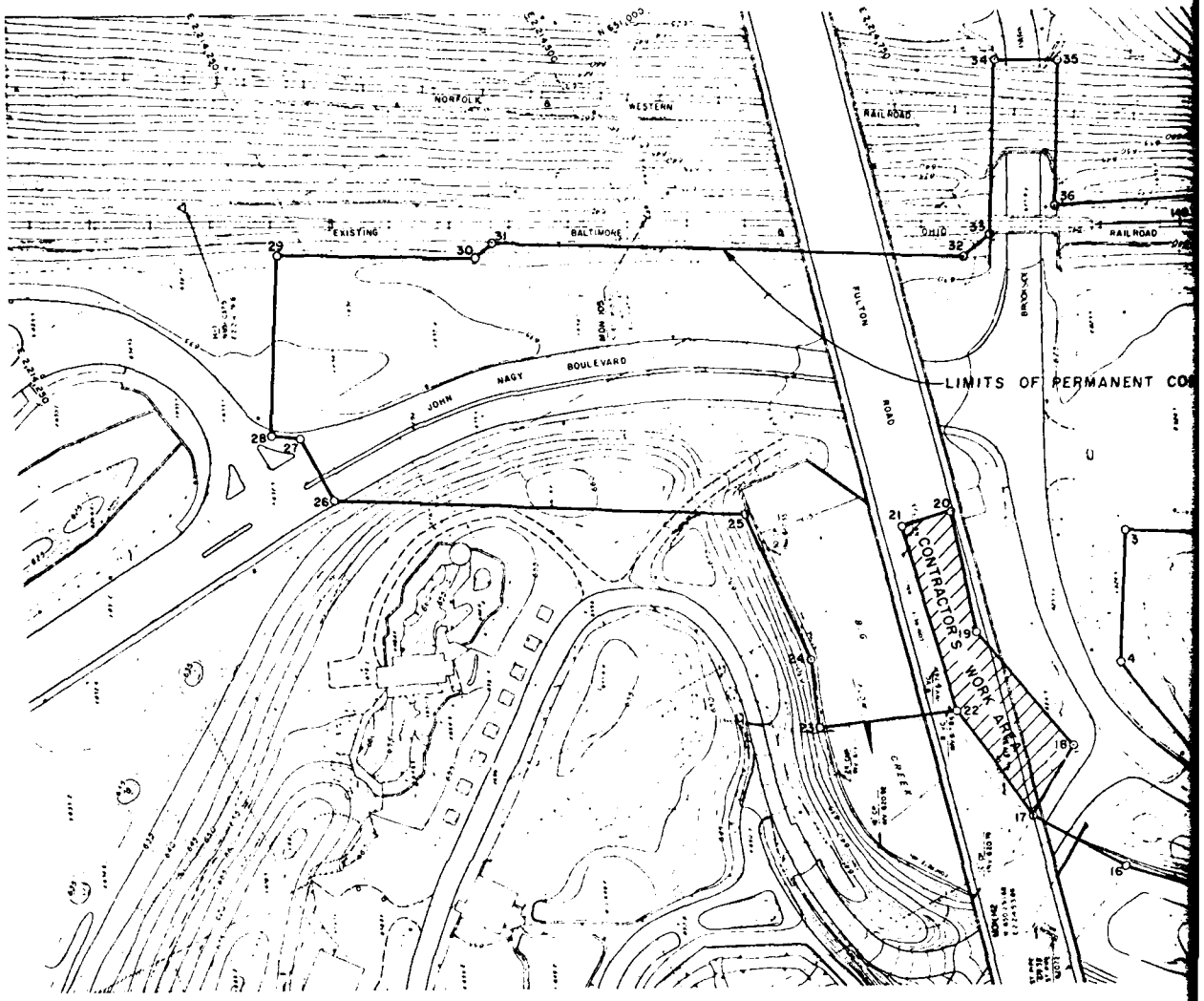
LIMITS OF PROPERTY ACQUI
SHEET 3 OF 4

BARNETT FLEMING CORDRY AND CARPENTER, INC
CONSULTING ENGINEERS

DRAWING NO.

SCALE 1 IN. = 80 FT | DATE JAN. 12, 1979 | SHEET

TO ACCOMPANY PHASE II GDM


NORFOLK & WESTERN RAILROAD
EXISTING
BALTIMORE & OHIO RAILROAD
JOHN NAGY BOULEVARD
FULTON ROAD
BROOKSIDE
LIMITS OF PERMANENT CO
CONTRACTOR'S WORK AREA
CREEK
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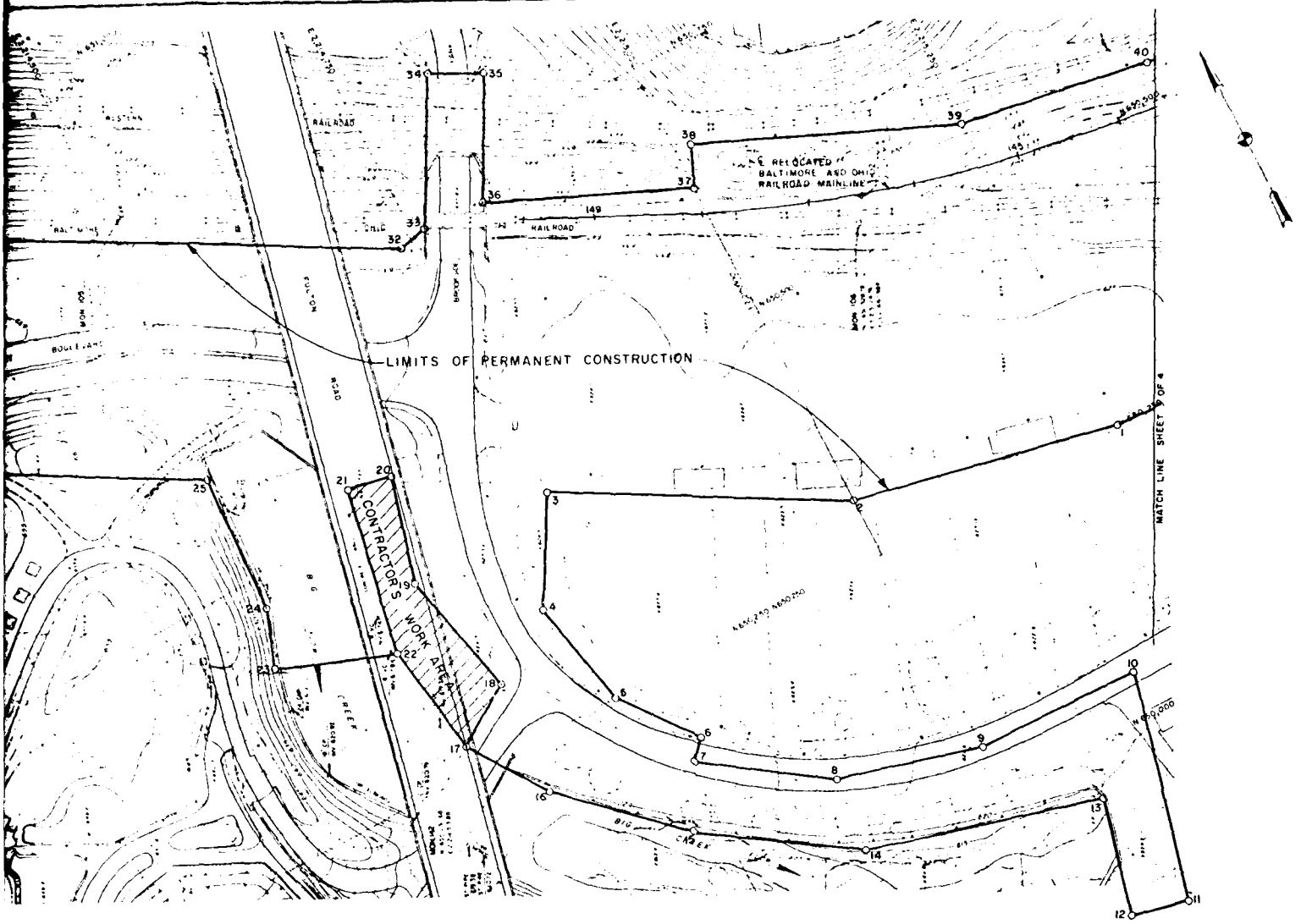

COORDINATES

POINT NO	COORDINATES NORTH	COORDINATES EAST	POINT NO	COORDINATES NORTH	COORDINATES EAST
1	650,254	2,215,250	21	650,534	2,214,588
2	650,306	2,215,000	22	650,380	2,214,558
3	650,446	2,214,750	23	650,419	2,214,451
4	650,352	2,214,697	24	650,473	2,214,471
5	650,250	2,214,719	25	650,603	2,214,477
6	650,182	2,214,771	26	650,768	2,214,177
7	650,164	2,214,755	27	650,826	2,214,176
8	650,088	2,214,865	28	650,839	2,214,155
9	650,051	2,215,000	29	650,967	2,214,228
10	650,046	2,215,157	30	650,892	2,214,373
11	649,836	2,215,104	31	650,896	2,214,390
12	649,849	2,215,050	32	650,705	2,214,735
13	649,957	2,215,078	33	650,712	2,214,763
14	650,017	2,214,860	34	650,835	2,214,830
15	650,107	2,214,725	35	650,811	2,214,876
16	650,201	2,214,624	36	650,706	2,214,823
17	650,275	2,214,574	37	650,629	2,215,000
18	650,311	2,214,632	38	650,666	2,215,016
19	650,429	2,214,602	39	650,565	2,215,250
20	650,525	2,214,630	40	650,534	2,215,429

TO ACCOMPANY PHASE II GDM

REAL ESTATE REQUIREMENT

REV	DATE	DESCRIPTION

U.S. ARMY ENGINEER DISTRICT, BUFFALO
CORPS OF ENGINEERS
BUFFALO, NEW YORK 14207

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

LIMITS OF PROPERTY ACQUISITIO
SHEET 4 OF 4

BANNETT FLEMING CORDDRY AND CARPENTER, INC
CONSULTING ENGINEERS

DRAWING NUMBER

SCALE: 1 IN = 50 FT | DATE: JAN 12, 1979 | SHEET

PLATE 38

BIG CREEK WATERSHED
CLEVELAND, OHIO
FLOOD PROTECTION

GENERAL DESIGN MEMORANDUM
PHASE II

APPENDIX C

HYDROLOGY AND HYDRAULICS

U. S. Army Engineer District, Buffalo
1776 Niagara Street
Buffalo, NY 14207

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SECTION C2

HYDRAULIC DESIGN

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TABLES

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SECTION C1

HYDROLOGY

C1.1 GENERAL

The Big Creek watershed is roughly triangular in shape with a total drainage area of 37.6 square miles. Rising in Royalton Township at elevation 1,220, Big Creek takes a northerly course for about 11 miles through Brooklyn Township, then an easterly course for four miles to its confluence with the Cuyahoga River, at elevation 579. The Big Creek watershed, shown on Plate C1, is about 9.5 miles in length, north to south, and about 6.5 miles in width, east to west. The reach of Big Creek studied during the Phase I Study extends from the mouth at the confluence with the Cuyahoga River, upstream to the drop structure in Brookside Park, a total of 2.8 miles.

C1.2 CLIMATOLOGY

There is a first order weather station located near the westerly edge of the Big Creek watershed at the Cleveland Hopkins Airport. This station has continuous record for approximately 105 years. In addition, the Sewer Control Systems Group of the Cleveland Ohio Regional Sewer District has maintained a system of recording rain gages since September 1972. Of these, three gages are located in the Big Creek watershed. The location of these gages and the Airport gage are shown on Plate C1.

C1.3 PRECIPITATION, SNOWFALL, AND TEMPERATURE

From 30 years of record, 1941 through 1970, normal annual and monthly values of precipitation, snowfall, and temperature were obtained. These data for the Cleveland Hopkins Airport Weather Bureau station are presented in subsequent paragraphs.

C1.4 The 30-year normal annual precipitation is 30.49 inches. The monthly values vary from a low of 2.18 inches in February to a high of 3.49 inches in both April and May.

C1.5 The 30-year normal annual snowfall for this station is 50.5 inches. Of the monthly means, the highest is 10.8 inches, occurring in February.

C1.6 The 30-year normal annual temperature for the station is 49.7 degrees Fahrenheit. July is the warmest month, and January the coldest month with average temperatures of 71.4 and 26.9 degrees Fahrenheit, respectively.

C1.7 NOTABLE STORMS

Storms which resulted in serious flooding in the Big Creek watershed include those of March 1913, March 1948, January 1959, June 1972, and August 1975.

C1.8 The greatest precipitation, and the most destruction from high winds and floods to occur, for which records are available, occurred in March 1913. Heavy rains occurred during the periods 13-15 and 20-21 March. These rains were only preliminary to the severe storm which developed during the period of 23-27 March. This storm extended from Texas to Lake Erie with its center over Bellefontaine, Ohio, 125 miles southwest of Big Creek. Two low-pressure centers combined to form a long trough of low pressure which caused excessive rainfall in Ohio and neighboring States for about 60 hours. Bellefontaine recorded a total of 11.16 inches of rainfall in 92 hours.

C1.9 The January 1959 storm caused severe damage not only in the Big Creek watershed but throughout the State of Ohio. The storm developed from a large mass of cold air over northwestern Canada, a flow of warmer air from the southwest and the associated frontal system. Heavy rains began on the 20th when the moisture-laden air from the south converged with the cold front. Although total rainfall for the storm was not excessive, intensities were high and runoff was increased by the frozen ground and the six-inch snow cover in the basin.

C1.10 The most recent damaging storm of record occurred on 24 August 1975. Rainfall from severe thunderstorm activity, between 1400 and 1900 hours, resulted in major damage in the Cleveland Metropolitan area as well as in the Big Creek Watershed. Approximately 2.13 inches of rainfall for this five-hour period was recorded at the Cleveland Hopkins Airport Weather Bureau with 1.13 inches falling between 1500 and 1600 hours and 0.88 inches falling between 1545 and 1600 hours. The Cleveland Sewer Authority rain gages are continuous recorders. As a result of power failures due to the severe thunderstorm activity, only total amounts were recorded. A total of 2.1, 2.64, and 4.98 inches of rainfall were recorded at the Parma, John Marshall, and Rhodes stations, respectively.

C1.11 RUNOFF AND STREAM FLOW DATA

There is one continuous recording stream gaging station operated by the U. S. Geological Survey, (USGS) on Big Creek. This gage is located in Brookside Park just upstream from the Cleveland Zoo, as shown on Plate C1, and provides data from which the runoff can be determined from the 35.3 square-mile drainage area. The

Table C1.1 - Maximum Annual Instantaneous Stage and Discharge Data at and Near the Brookside Park Gaging Station

Date	Stage in Feet	Discharge in CFS	
		USGS	Corps of Engineers
25 Mar 1913	-	-	10,000 (1)
22 Mar 1948	-	5,900 (1)	-
22 Jan 1959	-	6,000 (1)	-
28 Jul 1964	-	4,000 (1)	-
23 Jun 1972	-	8,400 (1)	-
20 Jul 1973	10.77 (3)	2,210 (4)	4,100 (6)
4 Apr 1974	9.25 (2)	1,700 (4)	3,250 (6)
24 Aug 1975	16.20 (3)	9,060 (5)	6,950 (7)

(1) Estimated.
(2) From USGS station record.
(3) High water mark related to USGS station datum.
(4) From USGS rating curve Number 1.
(5) From USGS rating curve Number 3, plotted on Plate C2.
(6) From COE water surface rating curve plotted on Plate C2.
(7) From COE energy rating curve plotted on Plate C2.

gaging station was established in October 1972 and has a continuous record to the present time. Table C1.1 lists the maximum annual instantaneous discharges for the period of record and peak discharges form some of the more notable floods which occurred prior to installation of the gage. The difference in the discharges of 9,060 cfs estimated by the USGS and 6,950 cfs estimated by Buffalo District for the August 1975 flood is explained in the following paragraphs.

C1.12 A stage-discharge relationship at the USGS gage in Brookside Park was derived from backwater computations. These computations were performed using computer program 723-X6-L202A, HEC-2, "Water Surface Profiles," developed by the Hydrologic Engineering Center in Davis, CA. These computations were supplemented by hand calculations for flow through the Cleveland Zoo and Brookside Park conduits. Backwater computations proceeded from the mouth of Big Creek upstream to the drop structure located in Brookside Park. Manning's roughness coefficients "n" for channel and overbank areas were assumed at 0.045 and 0.070, respectively. Expansion and contraction coefficients of 0.4 and 0.2, respectively, were used in these computations. A Manning's "n" values of 0.015 for the Brookside Park conduits and 0.020 for the Zoo conduits were used in the pipe flow computations.

C1.13 A number of high water marks for the August 1975 flood were established by Buffalo District, Cleveland Zoological, and USGS personnel. A great deal of difficulty was encountered in the reconstructing of the August 1975 profile by backwater computations using the USGS estimate of 9,060 cfs and the available high water marks data. Manning's "n" values and other backwater parameters were varied and further field surveys were made to verify the adequacy of the high water marks. Reconstruction of the August 1975 flood profile resulted in a water surface profile which was higher at all locations for which high water mark data were available. An investigation was then made to determine the adequacy of the USGS estimate of 9,060 cfs for the peak discharge of this flood. Based on these investigations, it was found that an estimate of 6,950 cfs is more realistic for the peak discharge of this flood.

C1.14 The stage at the USGS gage is increased by the limited capacity of the Brookside Park twin-barrel conduits which are located only 750 feet downstream from the gage. Stage-discharge curves at the USGS gage using both the water surface and energy elevations are shown on Plate C2. The USGS rating curve Number 3, at the gage is also plotted on Plate C2 for comparison.

C1.15 The USGS curve is well-defined up to 600 cfs by discharge measurements and fairly well-defined for flows greater than 6,000 cfs by slope-area computations. This curve does not reflect the efficiency of the Brookside Park conduits nor the channel in the park for

the intermediate discharges between 600 cfs and 6,000 cfs as shown on Plate C2. The Buffalo District curves obtained from the pipe flow and open channel flow equations are considered to reflect the flow conditions more accurately. The entrance to the twin-barrel conduits controls the stage discharge relationship in the upstream channel for discharges up to about 6,500. For larger discharges, this relationship is controlled by the tailwater downstream of the conduits. The stage-discharge relationship at the upstream side of the twin-barrel conduits was developed using critical flow conditions, orifice flow conditions, and pipe flow conditions. An orifice flow coefficient of 0.65 and a Manning's roughness coefficient of 0.012 were used in the pipe flow equations. The resultant stage discharge curve was used to determine starting water surface elevations for the backwater computations in the development of the stage-discharge relationship near the gage.

C1.16 The USGS estimate of 9,060 cfs for the peak discharge of the 24 August flood was determined from slope-area computations using high water marks obtained near the gage. These high water marks consisted of seed lines along the creek banks and mud line inside a telephone booth. These marks, when related to the gage, equalled a stage of 16.2 feet, as shown on Plate C2, which was considered to be the water surface elevation. However, the high water mark near the gage was taken from the inside of a telephone booth located on the right side in the flood plain, approximately 90 feet from the right channel bank. The average velocity at that cross section was about 7.0 feet per second in the channel and about 1.2 feet per second in the overbank. Manning's roughness coefficients are about 0.035 in the channel and 0.050 in the overbank areas. The Buffalo District considers the elevation of 16.2 feet indicative of the elevation of the energy grade line, i.e. water elevation plus velocity head. As shown by the Buffalo District energy elevation curve, the elevation of 16.2 feet equates to a discharge of 6,950 cfs. Using this discharge, backwater computations were made which resulted in satisfactory reproduction of the 24 August 1975 water surface profile.

C1.17 Based upon the discussions presented in previous paragraphs, 6,950 cfs was considered a better estimate than 9,060 cfs for the peak discharge for the 24 August 1975 flood. Further, the rating curve derived by the Buffalo District at the gage is considered more representative of the flow condition at the gage than the USGS rating curve. Therefore, this curve was used in this study to convert the stage-hydrograph for the 24 August 1975 flood to a discharge-hydrograph. This hydrograph, shown on Plate C3, was then used in the discharge-frequency determinations discussed in subsequent paragraphs.

C1.18 DISCHARGE-FREQUENCY DETERMINATIONS, EXISTING CONDITIONS, GENERAL

Prior to 1960, urbanization of the Big Creek watershed occurred mostly in the city of Cleveland at the lower end of the watershed. Subsequent to 1960, areas in the rest of the watershed have been urbanizing. At this time, the entire watershed is almost completely urbanized. Less than five percent of the remaining open land remains to be developed and is dispersed throughout the watershed. Consequently, the watershed was assumed to be completely urbanized and this necessitated consideration of the effects of urbanization on increased magnitude and frequency of flooding so that the proposed improvements would not be obsolete during the life of the project. A discharge-frequency curve for the study area was therefore derived by two methods which consider these effects.

C1.19 The first method involved rainfall-runoff studies using a unit hydrograph derived from the 24 August 1975 flood. This flood, one of the highest of record, reflects the runoff response of the watershed in its urbanized state. Another point is that this flood is the only one for which adequate rainfall and runoff data were available. Other storms resulted in relatively minor floods, and either rainfall or runoff data are inadequate or missing. The second method involves using a synthetic method to adjust a "Natural Conditions" discharge-frequency curve to reflect the increased magnitude and frequency of floods resulting from "Urbanized Conditions." A discussion of the methods and their use in determining a discharge-frequency curve for this study is discussed in subsequent paragraphs.

C1.20 DISCHARGE-FREQUENCY DETERMINATIONS, EXISTING CONDITIONS, RAINFALL-RUNOFF METHOD

Discharge-frequency determinations using the rainfall-runoff method proceeded in the following manner. The 24 August 1975 storm and flood hydrograph at the gage in Brookside Park was used to determine a 15-minute unit hydrograph by the Clark method of synthesis. This method is incorporated into computer program 723-X6-L2010, HEC-1, Flood Hydrograph Package developed by the Hydrologic Engineering Center of the Corps of Engineers in Davis, CA. The 24 August 1975 stage hydrograph was converted to a discharge hydrograph using the rating curve derived by the Buffalo District at the USGS gage and shown on Plate C2. Rainfall for this storm was compiled from records of the National Weather Service at the Cleveland Hopkins Airport and the Control Systems Group of the Cleveland Regional Sewer District. This rainfall, discussed in paragraph C1.10, was used in the Thiessen Polygon Method to determine a basin average rainfall amount. This amount was distributed in one-hour amounts using the time-distribution of rainfall as recorded at the Weather Bureau Airport

Station. A 15-minute distribution was then obtained based on intensity information provided by Airport Weather Bureau personnel. A time-area curve was derived for the watershed from U. S. Geological Survey quadrangle maps. This rainfall, time-area curve, and the runoff hydrograph were then inputed into HEC-1. Using the "Unit Hydrograph and Loss Rate Optimization Routine" HEC-1 resulted in the storm reproduction shown on Plate C3. The 15-minute unit hydrograph derived from this optimization is shown on Plate C4 and has a time of concentration, TC, of 1.50 hours and a channel storage, R, of 1.86 hours. HEC-1 loss coefficient values for STRKR, DLTKR, RTIOL, and ERAIN were 0.48 inches per hour, 1.42 inches, 6.94, and 0.68, respectively.

C1.21. The next step in the rainfall-runoff method is to develop runoff hydrographs for various frequency rainfalls using the 15-minute unit hydrograph and loss rates derived from the 24 August 1975 storm. Rainfall for various frequencies were determined from rainfall-intensity-duration-frequency curves published in Technical Paper 25 by the National Weather Service. The rainfall amounts are point rainfalls and are not reduced for drainage area effects - i.e., decreasing average precipitation for increases in drainage area. This is assumed reasonable as examination of the 24 August rainfall, and rainfall for other storms reveal a fairly constant rainfall amount between the Airport and Cleveland Sewer District stations for various durations. For example, an inch in an hour at each station, 1.5 inches in two hours, etc. Table C1.2 lists rainfall amounts determined from the TP-25 curves for various frequencies for an assumed duration of three hours. Three hours was assumed reasonable as a duration because it is somewhat in excess of the time of concentration, TC. Also, incremental amounts of rainfall for durations in excess of three hours were found to be very small, e.g., 0.01-inch, and would not be effective in producing runoff.

C1.22 These rainfall amounts were then distributed following the 24 August 1975 pattern and inputed into HEC-1 along with the 15-minute unit hydrograph and loss rate parameters derived from the August 1975 flood. Plate C5 shows the resulting runoff hydrographs. The peak discharges from these hydrographs were used to define the discharge-frequency curve shown on Plate C6. Table C1.2 lists the total rainfall inputed into HEC-1. By partially disregarding the natural randomness of runoff events, this method assumes the rainfall frequency will be the same as the runoff frequency. The impact of this assumption upon the final frequency is not known. Whether for this particular case, studies which could account for the true randomness of nature will result in a different discharge-frequency curve, and if it did what the magnitude of the differences would be, is open to question. But because the most significant factors influencing the runoff processes are accounted for in the adopted

Table C1.2 - Rainfall-Frequency Duration Data for the Cleveland Hopkins Weather Bureau Station

Time Hrs.	Cumulative Rainfall in Inches for Given Frequency					
	2-Yr.	5-Yr.	10-Yr.	25-Yr.	50-Yr.	100-Yr.
0:00	0.00	0.00	0.00	0.00	0.00	0.00
0:25	0.68	0.94	1.10	1.26	1.37	1.60
0:50	0.88	1.21	1.44	1.67	1.82	2.09
0:75	1.01	1.37	1.63	1.90	2.08	2.38
1:00	1.10	1.47	1.73	2.06	2.26	2.56
1:25	1.15	1.55	1.83	2.21	2.41	2.71
1:50	1.19	1.59	1.88	2.29	2.49	2.79
1:75	1.21	1.63	1.92	2.35	2.55	2.86
2:00	1.23	1.67	1.96	2.40	2.60	2.93
2:25	1.25	1.71	2.00	2.45	2.65	3.00
2:50	1.27	1.75	2.04	2.49	2.70	3.06
2:75	1.28	1.78	2.07	2.52	2.75	3.11
3:00	1.29	1.80	2.10	2.55	2.79	3.15

Table C1.2 - Rainfall-Frequency Duration Data for the Cleveland Hopkins Weather Bureau Station (Cont'd)

Time Hrs.	Cumulative Rainfall in Inches for Given Frequency					
	2-Yr.	5-Yr.	10-Yr.	25-Yr.	50-Yr.	100-Yr.
0:00	0.00	0.00	0.00	0.00	0.00	0.00
0:25	0.01	0.03	0.03	0.03	0.05	0.05
0:50	0.02	0.04	0.04	0.05	0.05	0.07
0:75	0.02	0.04	0.04	0.06	0.06	0.07
1:00	0.04	0.04	0.05	0.08	0.08	0.08
1:25	0.09	0.10	0.10	0.16	0.18	0.18
1:50	0.20	0.27	0.34	0.41	0.45	0.49
1:75	0.68	0.94	1.10	1.26	1.37	1.60
2:00	0.13	0.16	0.19	0.23	0.26	0.29
2:25	0.05	0.08	0.10	0.15	0.15	0.15
2:50	0.02	0.04	0.04	0.05	0.05	0.07
2:75	0.02	0.04	0.04	0.04	0.05	0.06
3:00	0.01	0.02	0.03	0.03	0.04	0.04
Total	1.29	1.80	2.10	2.55	2.79	3.15

procedure, it is not expected that any discharge-frequency curve which did account for all the random processes of nature would be significantly different from the one adopted for this report.

C1.23 DISCHARGE-FREQUENCY DETERMINATION, EXISTING CONDITIONS, SYNTHETIC METHOD

An alternative method was selected to check the adequacy of the discharge-frequency relationship obtained by the rainfall-runoff method previously discussed. A synthetic frequency method was used to adjust a "Natural Conditions" discharge-frequency curve to reflect the increased magnitude and frequency of floods resulting from "Urbanized Conditions."

C1.24 The discharge-frequency curve shown on Place C4 of the Review of Reports for Flood Control and Allied Purposes, Cuyahoga River, Ohio, dated 1969, was used as a Natural Conditions curve for this study. This curve is shown on Plate C6 of this report for comparison with the curves derived for Urbanized Conditions by both methods. This curve was developed using a method outlined in Bulletin 32, "Floods in Ohio, Magnitude and Frequency," dated 1959.

C1.25 The procedure used to determine the Urbanized Conditions curve from the Natural Conditions curve for Big Creek was developed by Franklin F. Snyder and presented in Paper 1808, "Synthetic Flood Frequency," published in the Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol. 84, No. HY5, October 1958. The procedure was developed for computing the flood discharge probability associated with a given rainfall-duration-frequency pattern on natural drainage basins, nonchannelized overland flow areas and areas with storm sewer drainage utilizing basin runoff producing characteristics of drainage area, channel length, slope and friction and basin shape. The approach is patterned after the so-called rational method and utilizes the time of concentration concept with a unit hydrograph interpretation, but recognizes and evaluates separately the effect of storage existing in all types of channels or conduits and an average rainfall-runoff-relation. The rainfall-runoff ratios presented in this paper were adjusted to reproduce the Natural Conditions curve. A frequency curve for urbanized conditions was then determined for the basin upstream of the gage by estimating the percentages of natural channels eliminated (40 percent) and area drained by storm sewers (60 percent) and the percent imperviousness (40 percent). These estimated percentages produced a reduction in time of concentration of about 37 percent and an increase in the amount of runoff for a given rainfall of 32 percent to 46 percent when compared to the values for natural conditions. The increase in peak flood

discharge after full development, due to the decrease in time of concentration and increase in runoff, was found to be about 1.63 times the natural conditions flow. The Natural Conditions and Urban Conditions discharge-frequency curves are shown on Plate C6 for comparison with the curve derived by the rainfall-runoff method.

C1.26 The above comparison indicates that the results obtained by the Snyder and rainfall-runoff methods are comparable. The rainfall-runoff method was considered the more accurate of the two methods used, as it is based on observed rainfall and runoff. The Snyder method is more theoretical and requires subjective judgement in determining the values of percent channels eliminated, percent area storm sewered and percent imperviousness. Therefore, the rainfall-runoff method curve was selected as the discharge-frequency curve for existing conditions for this study.

C1.26a There are only 2.3 square miles of local drainage area between the gage and the mouth. Because discharges from this totally urban area would run off faster than the time it would take for a flood from the remaining area to reach the gage, the selected discharge-frequency curve was considered applicable to all damage reaches in the study area.

C1.27 DISCHARGE-FREQUENCY DETERMINATIONS, IMPROVED CONDITIONS

The discharge-frequency curve for the existing conditions was assumed applicable under improved conditions. The justification of this assumption is presented in the following paragraph.

C1.28 Under existing conditions the peak discharge for the 24 August 1975 flood was estimated as 6,950 cfs as discussed in previous paragraphs. This discharge was used in backwater computations to satisfactorily reconstruct the flood profile from the mouth of Big Creek upstream through Brookside Park. This indicates that there is limited storage between the zoo and the mouth which affects peak flows. A flood hydrograph with a peak discharge of say 9,000 cfs at Brookside Park would have a peak discharge of 9,000 cfs at the mouth. The only difference would be in the time of peak.

C1.29 STANDARD PROJECT FLOOD, BROOKSIDE PARK GAGE

The standard project storm (SPS) determination was made in accordance with Civil Engineer Bulletin 52-8 (EM1110-2-1411) revised March 1965. SPS index rainfall was 11.0 inches for a duration of 96 hours. Since the Big Creek watershed meets the criteria for small drainage basins discussed in paragraph 2-03b of the above reference, the simplified procedure was used. This permitted the rainfall values to be determined directly from the depth-area curves without preparing an isohetal pattern for basin shape correction.

C1.30 The standard project flood (SPF) hydrograph at the Brookside Park gage was computed using the Hydrologic Engineering Center program, HEC-1. The total rainfall for the SPS amounted to 12.40 inches and, deducting losses of 4.77 inches, the runoff amounted to 7.63 inches. Losses were based on loss rate parameters determined from the 24 August 1975 storm study which was discussed in previous paragraphs. The SPF peak and lag time were calculated to be 30,000 cfs and 11.0 hours, respectively. The SPF hydrograph for this study is shown on Plate C7. Standard Project Flood stages were determined at the index points from backwater computations for a discharge of 30,000 cfs.

C1.30a The SPF determination described above was made using loss rate parameters derived from an analysis of the August 1975 storm. It might be logical, though, to expect less rainfall loss and higher intensity rainfall during an SPF than that experienced during an historical storm. To illustrate this and the effects on the SPF, an alternative analysis was performed using an initial loss of 0.5 inches and a uniform loss rate of 0.1 inches per hour. While the total rainfall would be the same for the SPF, 12.40 inches, losses were reduced from 4.77 to 3.88 inches and runoff increased from 7.63 to 8.52 inches. The resultant SPF peak discharge increased accordingly from 30,000 to 35,300 cfs.

C1.30b If the SPF had been selected as the design flood for improvements on Big Creek, then it might have been appropriate to consider, in more detail, the sensitivity of discharge and corresponding water levels to assumed loss rate parameters. As it was not selected, the above example is included herein for illustrative purposes only.

C1.31 DAMAGE REACHES AND INDEX POINTS

The location of index points and limits of the damage reaches were shown on Plate B1 of the Phase I GDM. The damage reaches were selected so that the areas within each reach would be flooded from the same source and be affected similarly by flooding and by the considered plan of improvement. The index point for each reach was selected as a point at which changes in water surface elevations would be representative throughout the reach. The location of the index points, a brief description of the damage reaches, and the discharges and stages for various frequencies were presented in Table B6.1 of the Phase I GDM.

C1.32 RATING CURVES FOR EXISTING CONDITIONS

For use in determining the average annual damages, stage-discharge curves for existing conditions are required at each index point. Backwater computations were performed for discharges ranging

from 500 cfs to 30,000 cfs from the mouth of Big Creek upstream to the drop structure in Brookside Park. These backwater computations were performed using computer Program 723-X6-L202A, HEC-2 referred to in paragraph C1.12. Manning's roughness coefficients and contraction and expansion coefficients used in existing conditions are also presented in paragraph C1.12. Elevations from the backwater computations were plotted versus discharges at each index point. Smooth curves were then drawn through these points to complete the rating curves for existing conditions. These stage-discharge curves are shown on Plates C8 through C10.

C1.33 RATING CURVES FOR IMPROVED CONDITIONS

Water surface profiles for improved conditions with diversion channels were computed. Manning's roughness coefficients used in these computations are 0.025 for earthen channel, 0.03 for riprapped channels, and 0.015 for concrete channels. Stage-discharge curves at index points 2 and 3 for improved conditions are shown on Plates C9 and C10. Also, the frequency, stage, and discharge values at index point 2 are shown on Table C1.3. As stated on Plate C8, there is no change in the rating curve at index point 1.

Table C1.3 - Frequency-Stage-Discharge Values at Index Point 2

Frequency	Main Channel				Diversion Channel	
	Existing Conditions		Improved Conditions		Improved Conditions	
	Stage	Discharge	Stage	Discharge	Stage	Discharge
20	609.7	8,400	603.8	3,000	603.1	5,400
50	612.6	10,200	605.0	4,000	603.6	6,200
100	614.4	12,000	606.6	5,000	604.4	7,000
200	615.4	14,000	607.7	5,600	604.7	8,400
SPF	620.0	30,000	614.6	10,000	609.4	20,000

NOTE: All stages refer to U.S.C. & G.S. Datum.
All discharges are in cubic feet per second.

C1.34 STAGE-FREQUENCY CURVES, EXISTING CONDITIONS

For determining existing average annual damages, stage-frequency curves for the index points were developed from the

existing conditions stage-discharge curves for the same index points and the existing conditions discharge-frequency curve obtained by the rainfall-runoff method. The existing conditions stage-frequency curves for three index points are shown on Plates C11 through C13.

C1.35 STAGE-FREQUENCY CURVES, IMPROVED CONDITIONS

Stage-frequency curves for reaches 2 and 3 under improved conditions were developed for the index points for the seven alternative designs considered in the Phase I GDM. The appropriate curves for the diversion channel scheme are shown on Plates C12 and C13 as dashed lines. Stage-frequency curves in the vicinity of index points for the diversion channel are also shown on Plates C12 and C13.

C1.36 WATER SURFACE PROFILES

Water surface profiles under existing conditions from the mouth of Big Creek upstream to the upstream face of the twin-barrel conduits in Brookside Park are shown in Plates C14 and C15 for discharges of 12,000 cfs (100-year discharge), 6,950 cfs (August 1975 flood) which is the most recent major flood, and 30,000 cfs (Standard Project Flood Discharge). The starting water surface elevations at the mouth for computing water surface profiles were selected from a stage-frequency relationship for the Cuyahoga River. The water surface elevation at index point 1 for the 100-year discharge (12,000 cfs) are the same using two different starting water surface elevations at the mouth, a 100-year stage and a 10-year stage. Therefore, the starting water surface elevations at the mouth has no effect on the water surface elevations within the project limits for all flows including the SPF discharge. The water surface profile in the main channel under improved conditions for 12,000 cfs is shown on the same Plates C14 and C15. This improved profile is obtained for the discharges of 6,000 cfs in the reach between Station 121+50 and Station 74+20 and 5,000 cfs in the reach between Station 70+50 and Station 54+00. The remaining discharges in the above reaches are in the diversion channels. The water surface profiles in the diversion channels are also shown on Plates C14 and C15.

SECTION C2

HYDRAULIC DESIGN

C2.1 GENERAL

Hydraulic structures designed for the Big Creek local protection project consist of concrete chute spillways, diversion channels low drop structures, and modifications to existing channels. The main report shows a plan view of the project. The limits and type of improvements included in the projected design are shown on Plates C14 and C15. In the project area, the slope of the stream bed changes at several locations from mild to steep. The stream flow passes through sub-critical, super-critical and transition flow conditions. Also, there are two reaches totalling 2,000 feet where Big Creek flows in concrete conduits. One reach is in Brookside Park with a length of 500 feet and the other reach is in the zoo with a length of 1,500 feet. The references used in developing hydraulic design for the project are:

a. Hydraulic charts for the selection of Highway Culverts, Hydraulic Engineering Circular No. 5, published by U. S. Department of Commerce, Bureau of Public Roads, April 1964;

b. Hydraulics of Closed Conduit Spillways, Part 1, Theory and its Application by F. W. Blaisdell, U. S. Department of Agriculture, 1952;

c. Hydraulic Design of Stilling Basins and Energy Dissipators by A. J. Paterka, Engineering Monograph No. 25, U. S. Department of Interior Bureau of Reclamation, July 1963; and

d. Open Channel Hydraulics by Ven Te Chow, McGraw-Hill Brook Company, 1959.

C2.2 DESIGN DISCHARGE

The design discharge for the considered plan of improvement was selected in the Phase I GDM to provide the highest degree of protection based on the following considerations:

a. Provision of an adequate degree of protection for the type and degree of development in the flooded area;

b. Maximum capacity available through the existing structures without extensive alterations or replacement;

c. Preserving the natural environment;

d. Maximization of benefits from considered improvements;

e. Consistency with good flood plain management practices, particularly those associated with the National flood insurance program; and

f. Minimum degree of protection (50-year) acceptable to officials of the Cleveland Zoological Park necessary to implement the proposed zoo "redevelopment plan."

C2.3 A discharge of 12,000 cfs was selected as the design discharge for the plan of improvement. This discharge has a recurrence interval in the order of once in 100 years. During the Phase II study an attempt was made to maximize the flow capacity of the project features to provide for a greater than one percent flood. However, because of the space limitation between the 25th Street bridge piers, the maximum discharge that passes through this restriction without causing excessive tail water upstream of the diversion B is 12,000 cfs.

C2.4 DIVERSION CHANNEL

To preserve to the maximum possible extent, the natural setting of the Cleveland Zoo and to provide the maximum degree of protection to the industrial complex just downstream of the zoo, diversion channels, wherever possible, to carry flows exceeding the creek's capacity are a major component of plan of improvements.

C2.5 CHANNEL DESIGN

Channel diversions and grades for the alternatives investigated were established from backwater computations made in accordance with instructions contained in EM 1110-2-1409, "Backwater Curves in River Channels." Manning's roughness and energy loss coefficients used in the backwater computations are given in paragraph C1.12.

C2.6 In the area of the diversion channel, the channel sections were designed with a trapezoidal cross section having slide slopes 1 vertical on 2.5 horizontal. The diversion channel alignment was selected based on current topographic maps, field inspection, and maximum land utilization. Manning's roughness coefficients of 0.025 for grassed channel; .030 for channel with a berm and rock bottom; and 0.035 for ripprapped channels were used in the design of the diversion channels.

C2.7 The capacity of the existing conduits were determined using the theory of flow-through culverts presented in the references a and b listed in paragraph C2.1. For low flows, the control section is at

the conduit entrance where the flow depths become critical. As the water surface reaches the crown, the conduit entrance will be sealed off resulting in orifice flow conditions which control the flow until the head upstream of the conduits is substantially high, or the tailwater forces the conduits to flow full. The capacities of the existing conduits are determined from the pipe or orifice flow equations depending on the flow conditions. The coefficients used in these equations are 0.6 for discharge coefficient in orifice flow equation, 1.5 for entrance, exit, and minor loss coefficient in pipe flow equation, and Manning's roughness coefficient "n" in the friction loss term of the pipe flow equation of 0.015 in the park conduits and 0.020 in the zoo conduits.

C2.8 BANK PROTECTION

Bank protection is provided upstream and downstream of bridges, on the outsides of sharp channel bends, and at locations where the average channel velocity would exceed six feet per second. In those areas where the channel is being excavated in rock, no bank protection is required. The determination of riprap gradation limits has been designed in accordance with EM 1110-2-1601, dated July 1970 and ETL 1110-2-120, dated May 1971. The full capacity of the existing creek was utilized to carry the design flow. Consequently, flooding will commence in the project area for any discharge exceeding 12,000 cfs even though the "Floodway" and "Diversion Channels" have been designed with freeboard allowances as stated in EM 1110-2-1601 (paragraph 12a(3)). Since flooding will commence for flows exceeding the design flow, no additional computations were made to evaluate the additional discharge that could be confined by the designed project features.

C2.9 INTERNAL FLOOD CONTROL

Drainage behind the small area of land fill and small levee to be constructed at the upstream end of the project will flow into the improved channel and existing internal drainage systems, consequently, interior flood control measures are not required.

C2.10 DESIGNED PLAN

The plan of improvement for flood control on Big Creek consists of improving the capacity of the existing creek and diverting excess waters through diversion channels away from the areas where excessive damage occurs. Improvements also consist of modifying existing channels, transitions, energy dissipators, and widening and removing railroad bridges. These improvements start near the zoo at Station 118+30 and continue downstream to Station 54+00. The plan provides for approximately one mile of diversion channels and 0.4 miles of

improvements to the existing creek channel. The limits of improvements, the existing and improved 100-year water surface profiles and August 1975 flood are shown on Plates C14 and C15.

C2.11 The design discharge for the selected plan is 12,000 cfs. At the upstream face of the park conduits, Station 121+50, the design discharge is split so that 6,000 cfs flows through the existing park conduits and the remaining 6,000 cfs flows over the roads at the water surface elevation of 639.0 which is the same elevation under existing conditions. The park conduits, the existing Big Creek channel between the park and zoo conduits and the triple-barrel conduits are adequate to pass 6,000 cfs at a stage of 627.0 in the zoo channel. This requires an average fill of 2.5 feet deep in the vicinity of the zoo channel. An energy dissipator is required at the downstream end of the zoo conduits, Station 90+00.

C2.12 Diversion "A" starts at Station 118+30 which is 320 feet downstream from the upstream face of the park conduits and ends at Station 88+20 which is 200 feet downstream from the zoo conduits. This diversion is 2,680 feet long and consists of a concrete chute spillway, a hydraulic jump stilling basin, trapezoidal channels, and drop structures. The channel bottom and water surface profiles are shown on Plate C15. A 200-foot long hydraulic jump basin is designed at the downstream end of the chute spillway. This basin also provides a transition for the road intersection. The stage-discharge curves for the hydraulic jump basin are shown on Plate C17. Trapezoidal channels having side slopes 1 vertical to 2.5 horizontal side slopes are designed for this reach.

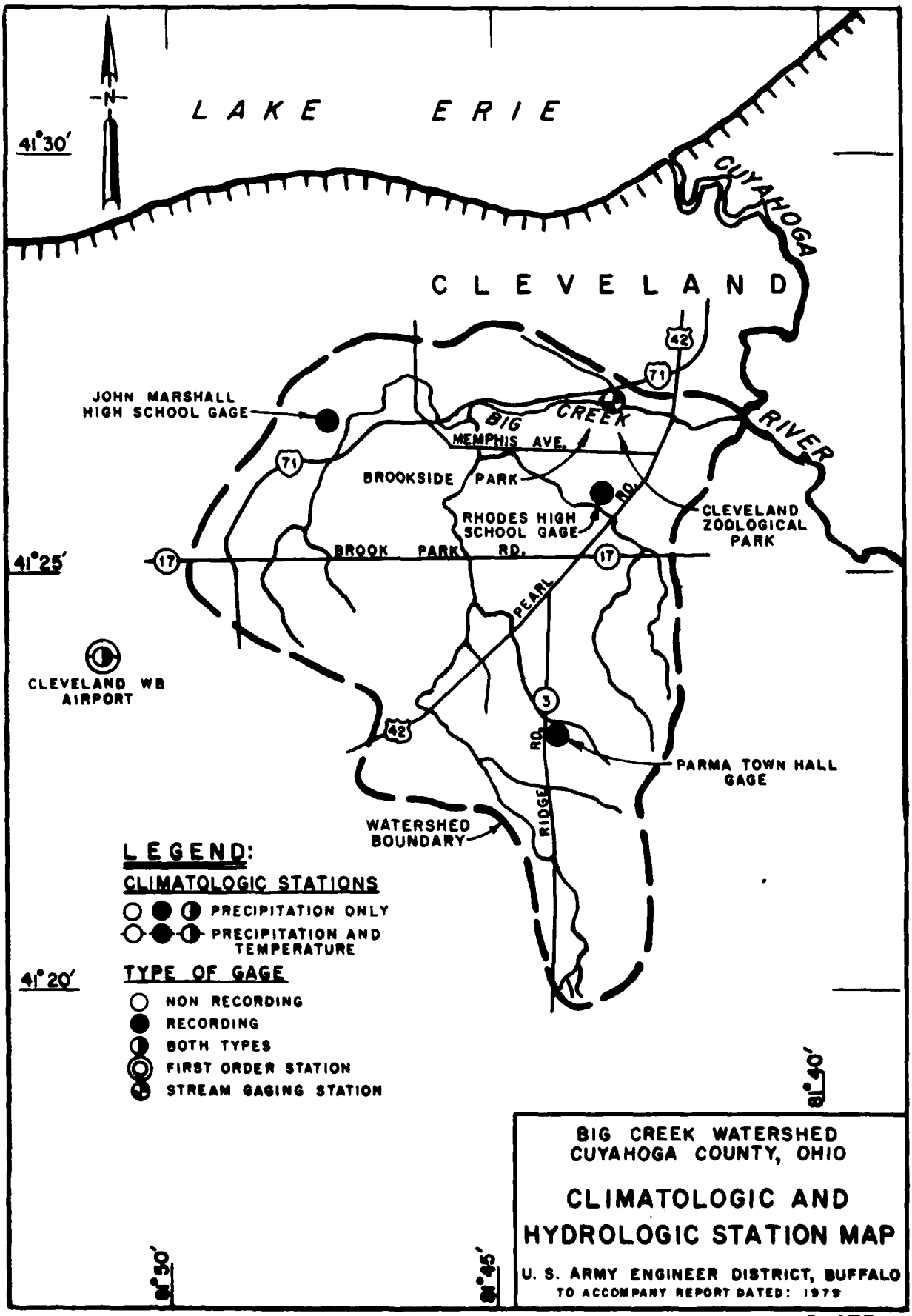
C2.13 The combined flow of 12,000 cfs flows through the improved creek between Stations 88+20 and 70+00. This improved creek is a compound trapezoidal channel having variable bottom width and 1 vertical to 2 horizontal side slopes. This reach also provides a three-foot deep, 30-foot wide trapezoidal low flow channel. The existing B & O Railroad bridge at Station 71+00 is removed and the tracks are relocated over the widened N & W Railroad bridge at Station 70+00.

C2.14 Diversion "B" starts at the upstream face of the N & W Railroad bridge at Station 70+00. Of the total discharge, 5,000 cfs flows in the main creek between Stations 70+00 and 54+00. The existing creek capacity in this reach is adequate to pass the discharge of 5,000 cfs within bank.

C2.15 The remaining discharge of 7,000 cfs is diverted through a 50-foot long concrete weir followed by a 100-foot long and 50-foot wide rectangular concrete chute. A 40-foot long concrete paved transition is required between the rectangular chute and trapezoidal channel. This trapezoidal channel has a 50-foot bottom width and 1 vertical to

2 horizontal side slopes. A 860-foot long high velocity channel with a 50-foot bottom width and 1 on 2 side slopes is required where it joins the main channel at Station 54+00. No improvements are provided downstream from Station 54+00.

C2.16 The SPF flooded outlines in the project area, with and without the designed project, are shown on Plate C16.

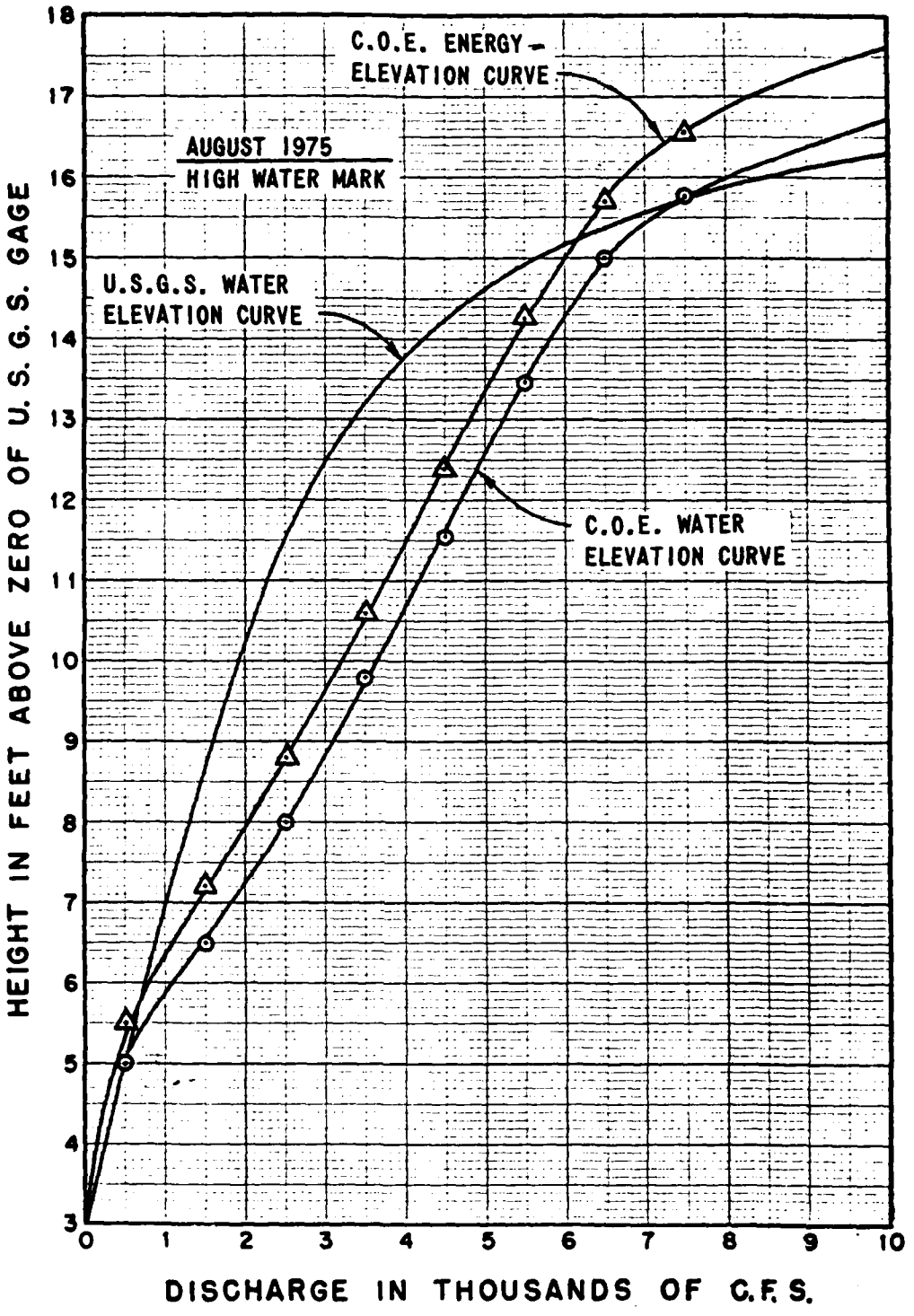


BIG CREEK WATERSHED
CUYAHOGA COUNTY, OHIO

CLIMATOLOGIC AND HYDROLOGIC STATION MAP

U. S. ARMY ENGINEER DISTRICT, BUFFALO
TO ACCOMPANY REPORT DATED: 1979

PLATE C1



NOTES:

ZERO OF GAGE - 620.7 U.S.C. & G.S. DATUM.

U.S.G.S. GAGE IS LOCATED ON THE DOWNSTREAM SIDE OF THE FOOTBRIDGE IN BROOKSIDE PARK, 750 FEET UPSTREAM FROM THE BROOKSIDE PARK CONDUITS.

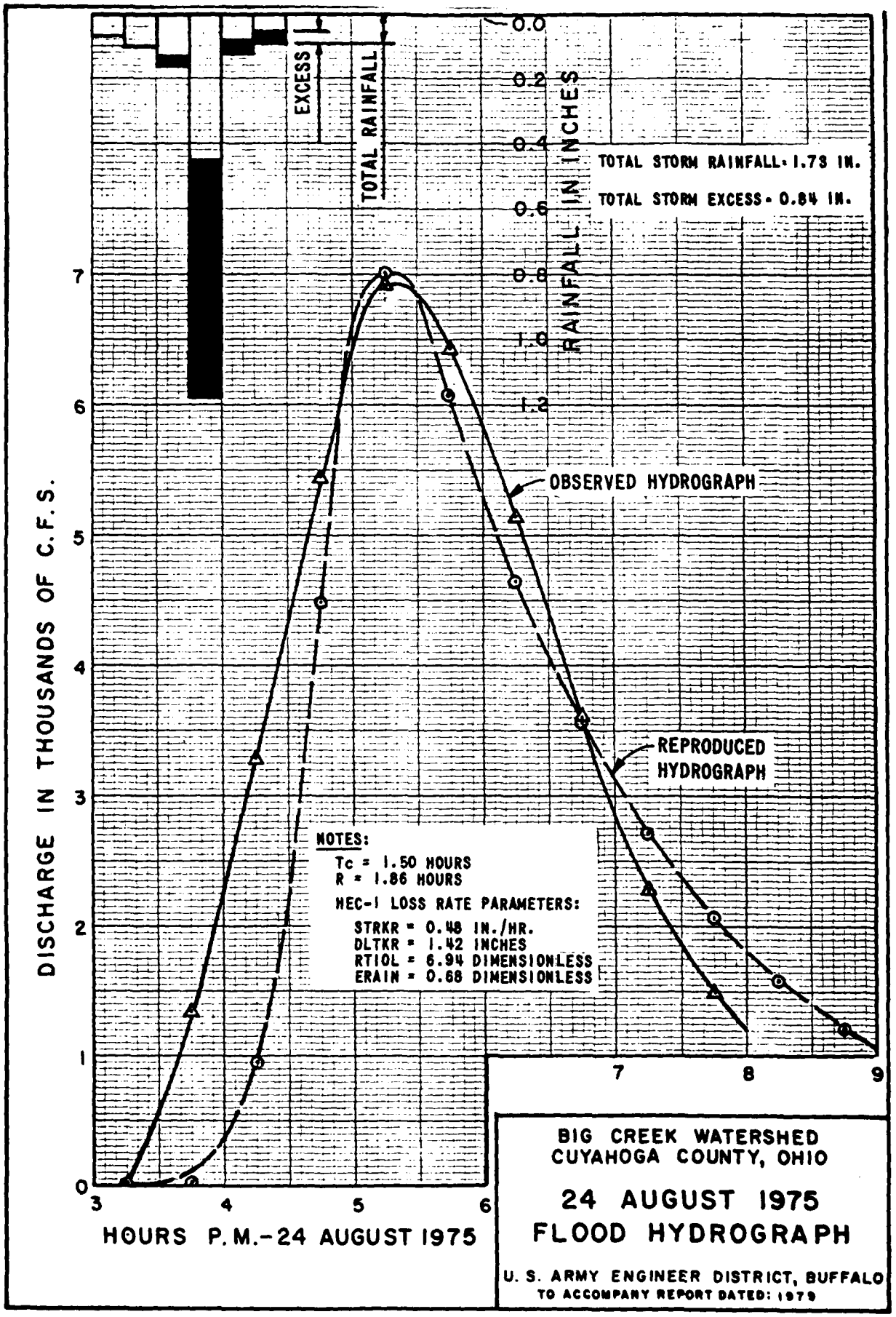
C.O.E. - CORPS OF ENGINEERS

BIG CREEK WATERSHED
CUYAHOGA COUNTY, OHIO

STAGE-DISCHARGE CURVES U. S. G. S. GAGE AT BROOKSIDE PARK

U. S. ARMY ENGINEER DISTRICT, BUFFALO
TO ACCOMPANY REPORT DATED: 1979

PLATE C2

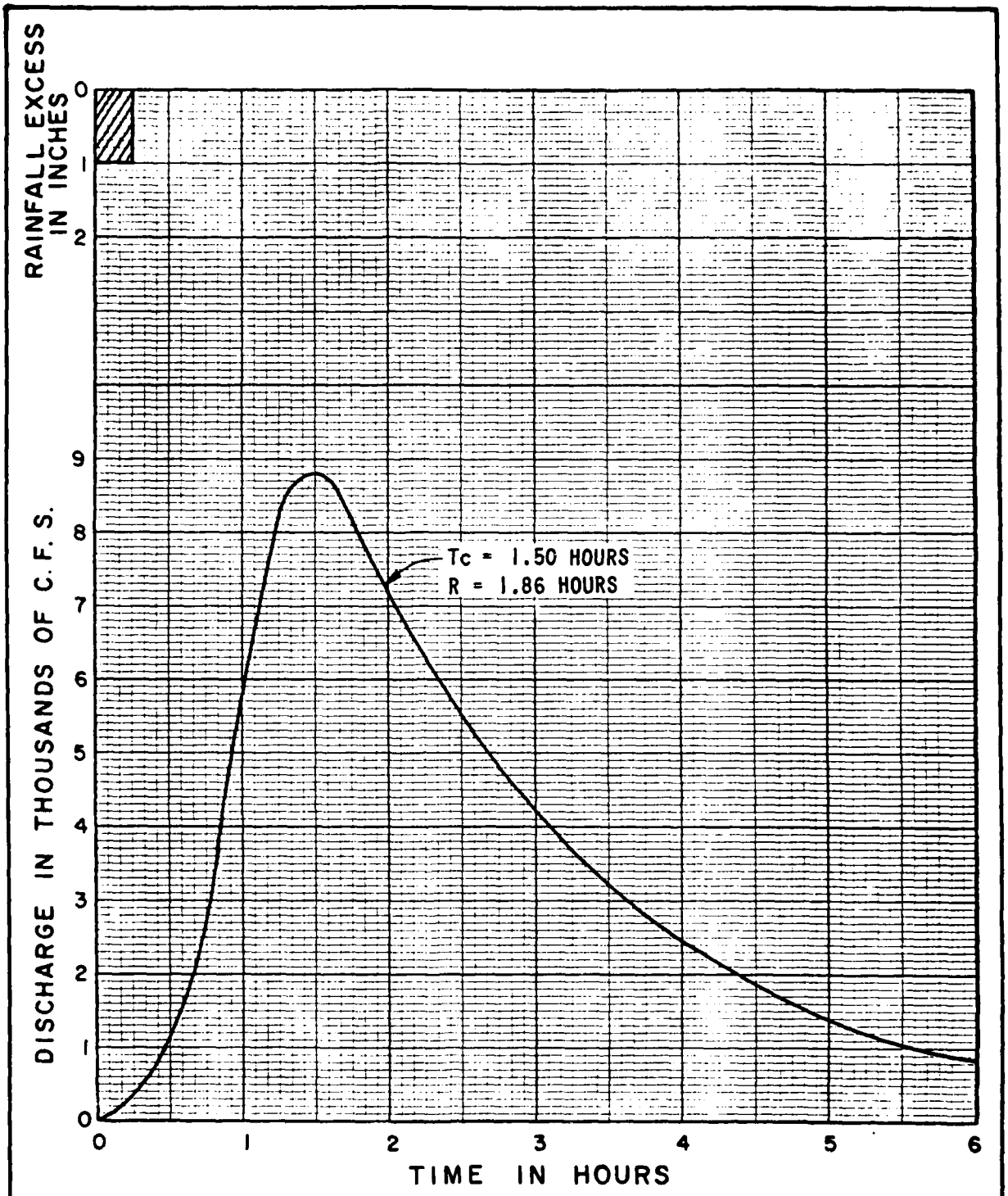


BIG CREEK WATERSHED
CUYAHOGA COUNTY, OHIO

24 AUGUST 1975 FLOOD HYDROGRAPH

U. S. ARMY ENGINEER DISTRICT, BUFFALO
TO ACCOMPANY REPORT DATED: 1979

PLATE C3



NOTES:

UNIT HYDROGRAPH DERIVED FROM STUDY OF 24 AUG. 1975 FLOOD HYDROGRAPH AT THE U.S.G.S. GAGE IN BROOKSIDE PARK.

DRAINAGE AREA = 35.3 SQ. MI.

HEC-1 LOSS RATE PARAMETERS:

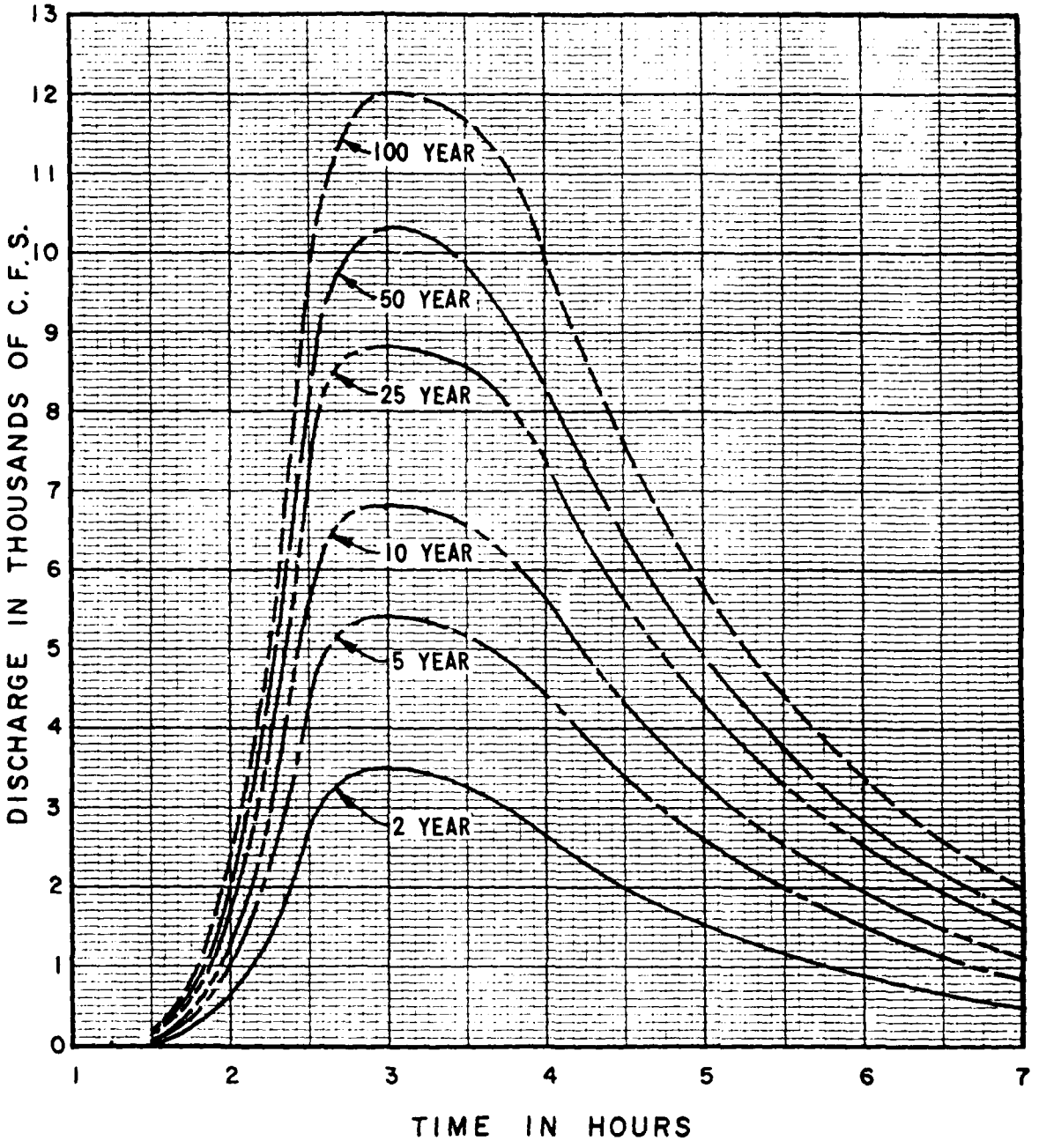
STRKR = 0.48 IN/HR.
DLTKR = 1.42 INCHES
RTIOL = 6.94 DIMENSIONLESS
ERAIN = 0.68 DIMENSIONLESS

BIG CREEK WATERSHED
CUYAHOGA COUNTY, OHIO

15-MINUTE UNIT HYDROGRAPH

U. S. ARMY ENGINEER DISTRICT, BUFFALO
TO ACCOMPANY REPORT DATED: 1979

PLATE C4



NOTES:

RUNOFF HYDROGRAPH DERIVED BY APPLYING TP-25 RAINFALL, SHOWN IN TABLE A2, TO 15 MINUTE UNIT HYDROGRAPH DERIVED FROM 24 AUGUST 1975 FLOOD AT U.S.G.S. GAGE IN BROOKSIDE PARK.

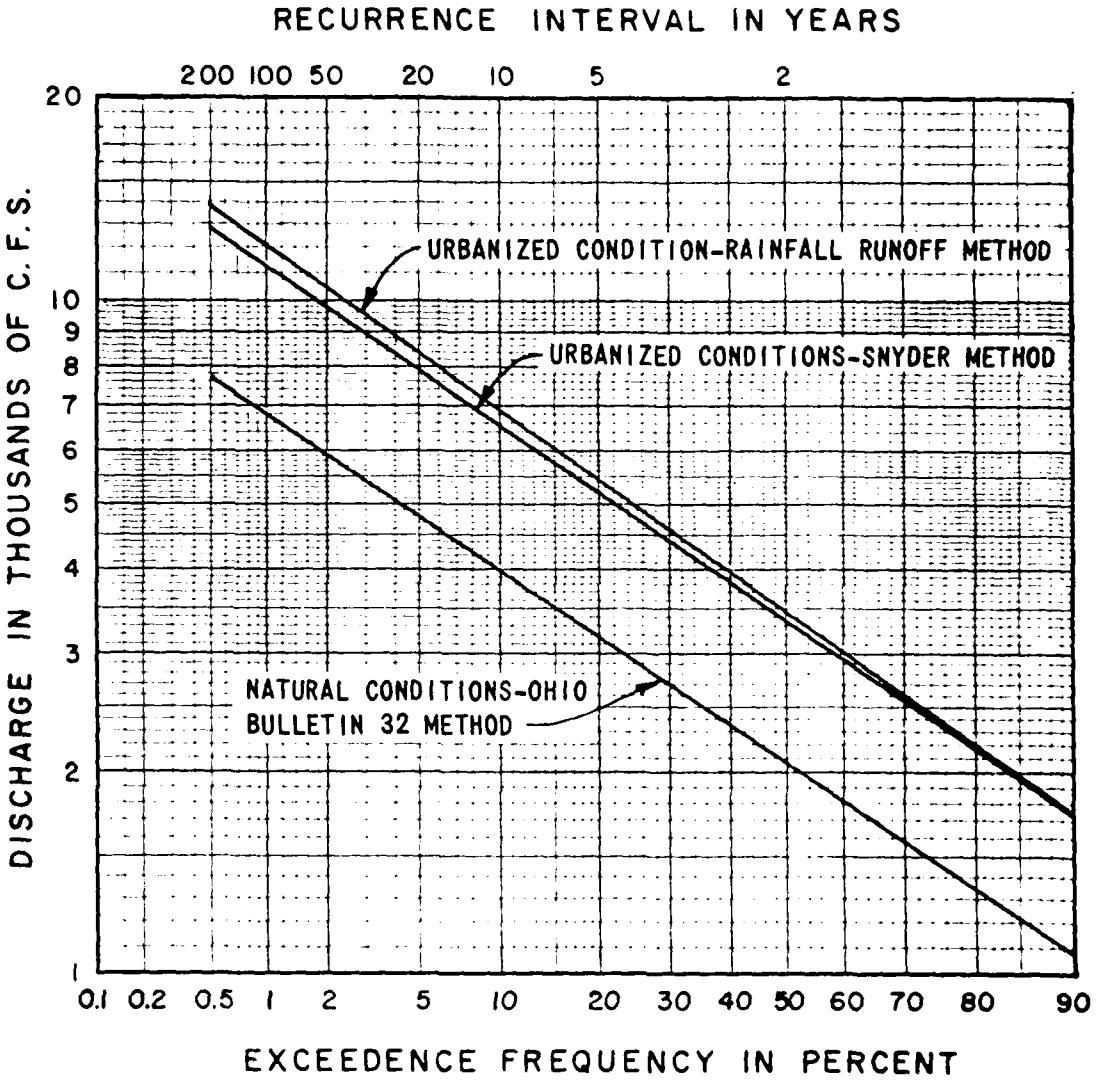
DRAINAGE AREA = 35.3 SQUARE MILES.

BIG CREEK WATERSHED
CUYAHOGA COUNTY, OHIO

RUNOFF HYDROGRAPHS

U. S. ARMY ENGINEER DISTRICT, BUFFALO
TO ACCOMPANY REPORT DATED: 1979

PLATE C5



NOTES:

DERIVED FROM THE U.S.G.S. GAGE IN BROOKSIDE PARK.

DRAINAGE AREA = 35.3 SQUARE MILES.

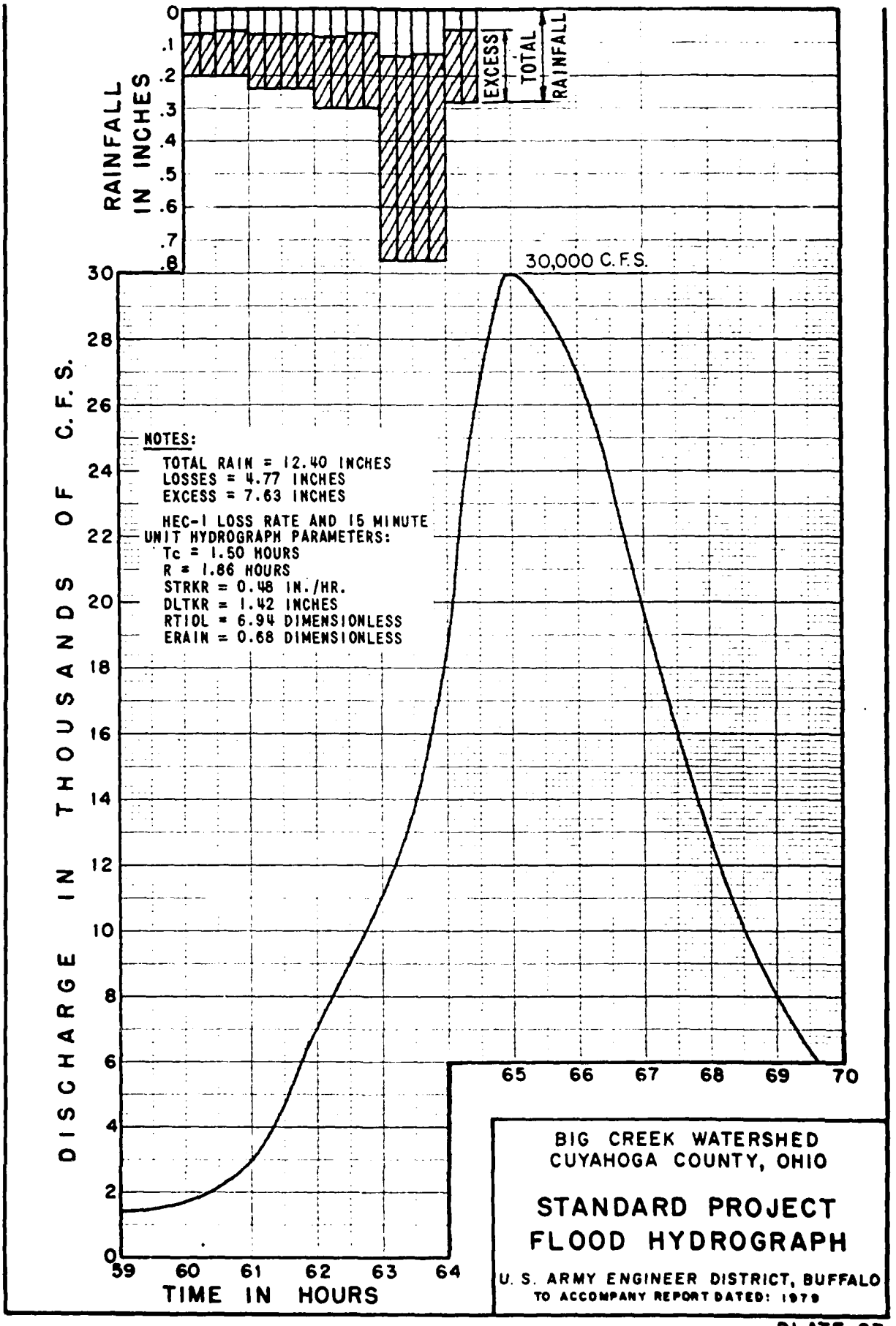
ASSUMED APPLICABLE TO ALL REACHES UNDERSTUDY.

BIG CREEK WATERSHED
CUYAHOGA COUNTY, OHIO

DISCHARGE-FREQUENCY CURVES

U. S. ARMY ENGINEER DISTRICT, BUFFALO
TO ACCOMPANY REPORT DATED: 1979

PLATE C6

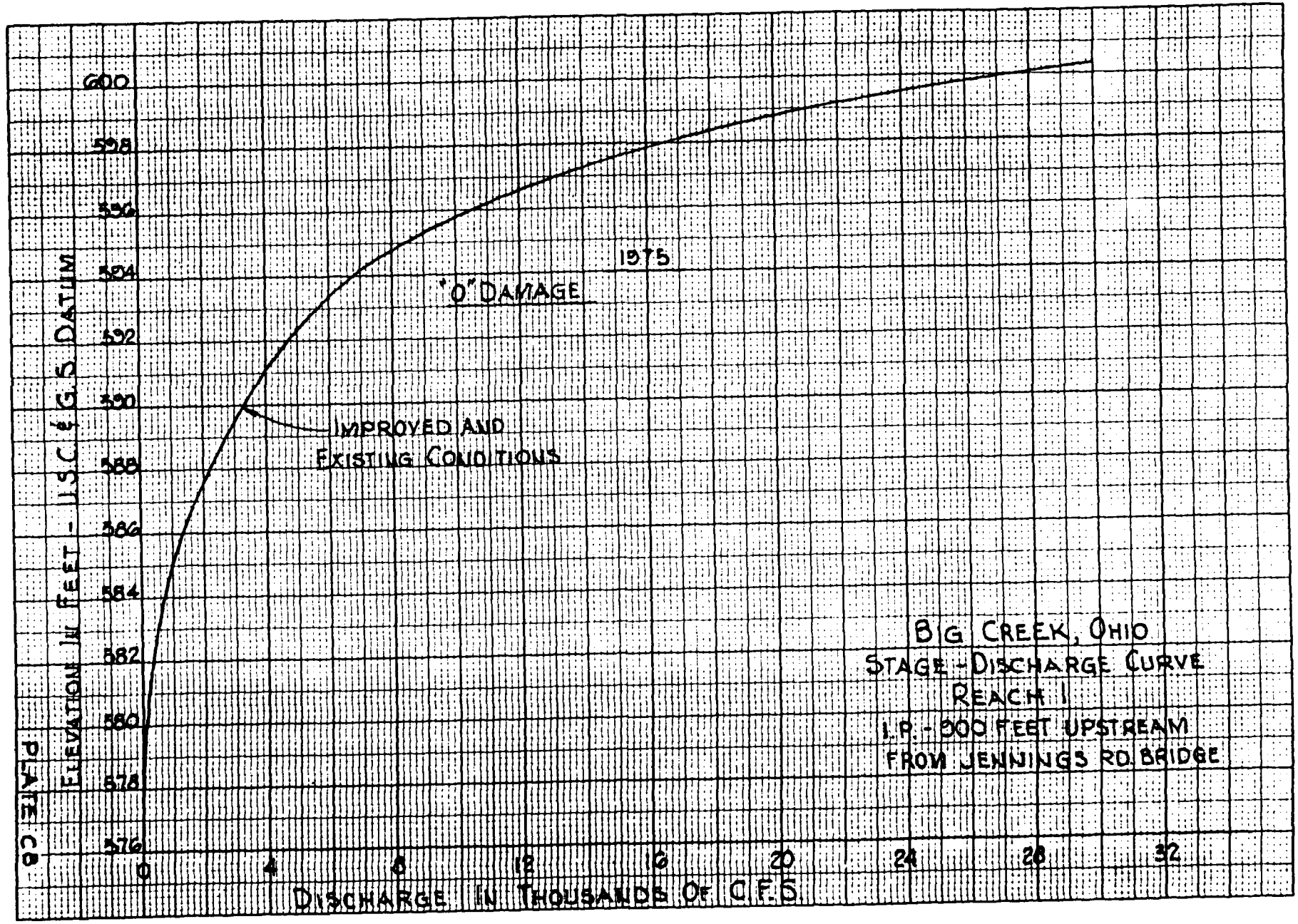


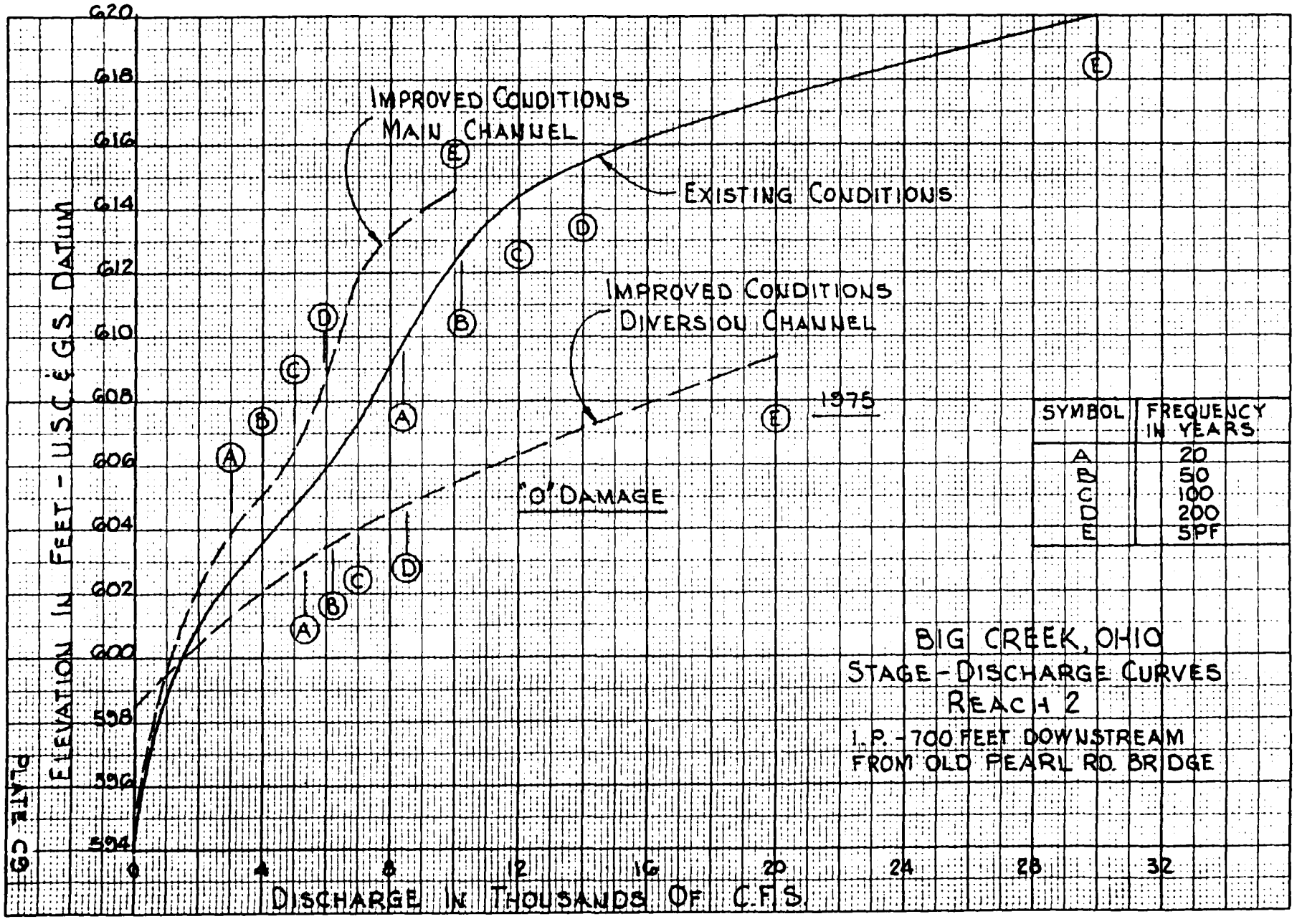
BIG CREEK WATERSHED
CUYAHOGA COUNTY, OHIO

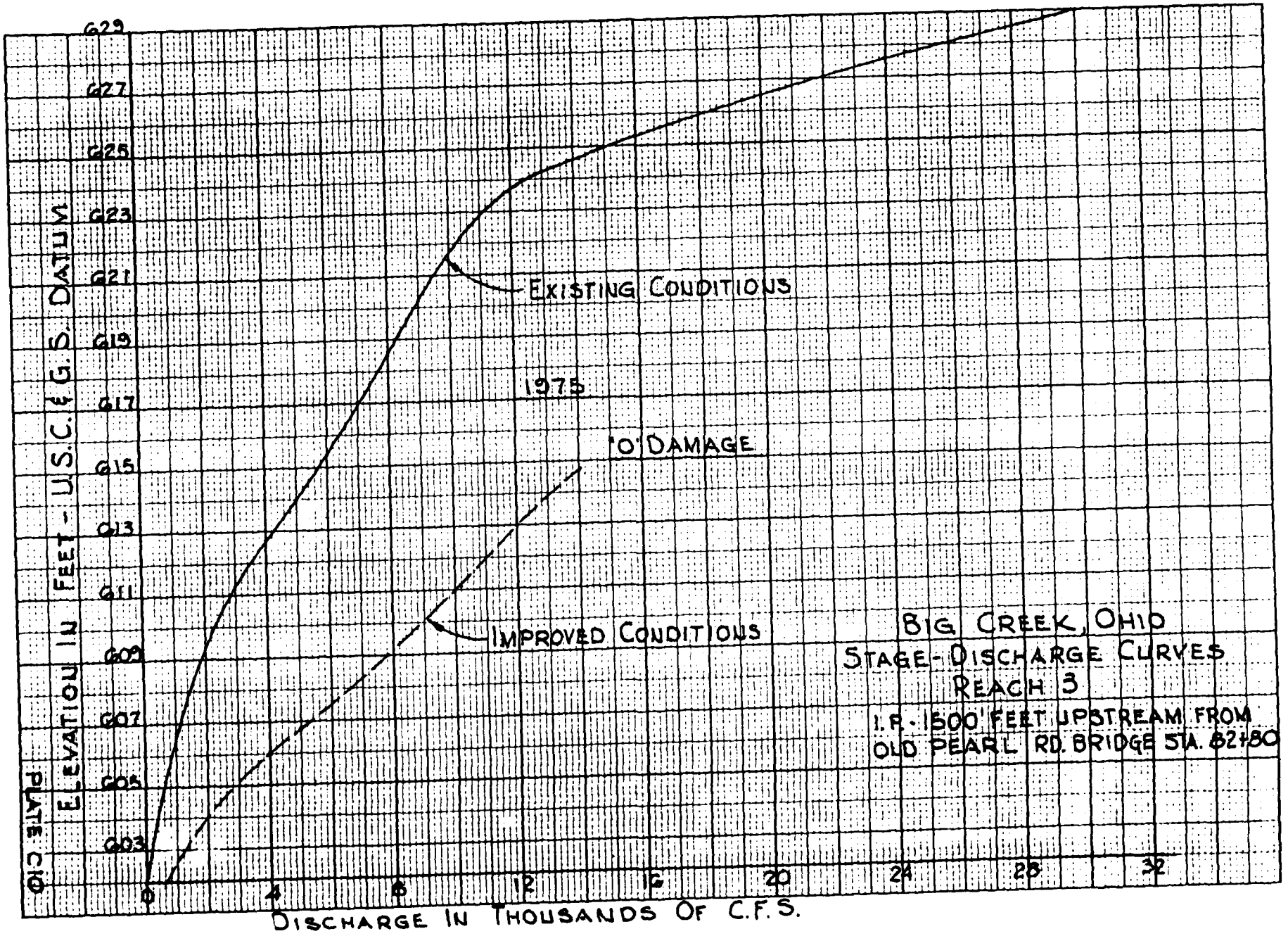
STANDARD PROJECT FLOOD HYDROGRAPH

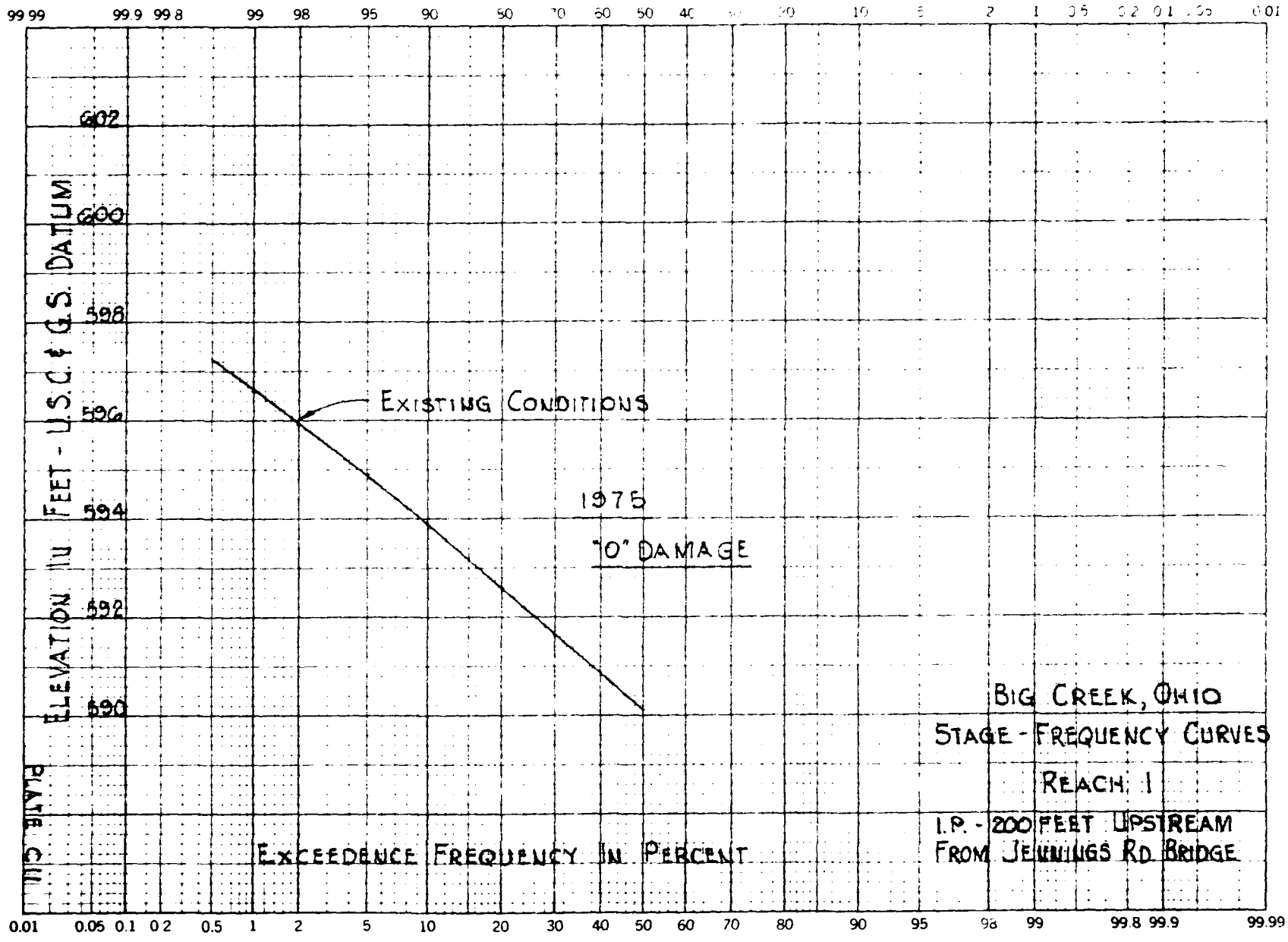
U. S. ARMY ENGINEER DISTRICT, BUFFALO
TO ACCOMPANY REPORT DATED: 1978

PLATE C7









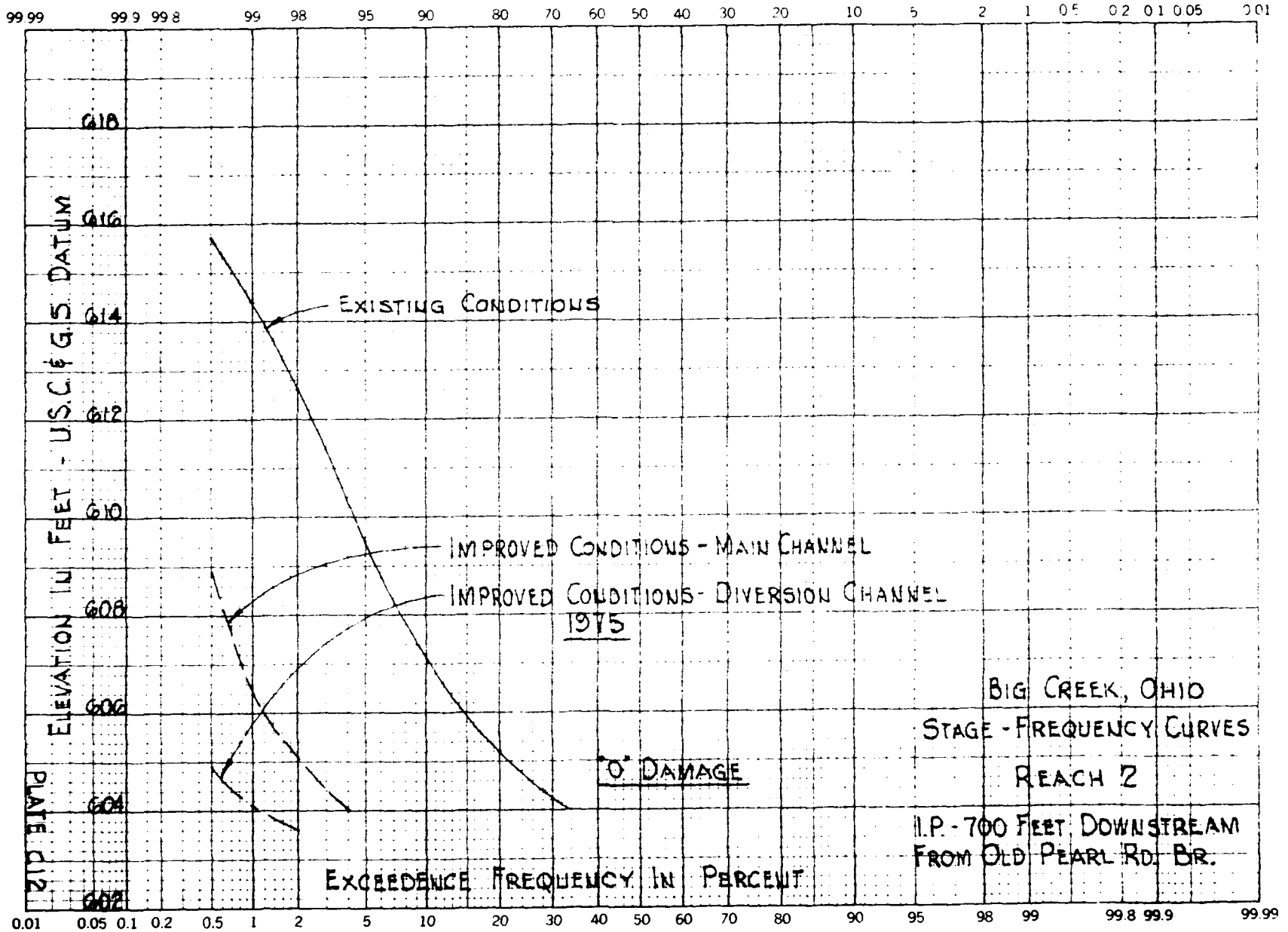


PLATE C12

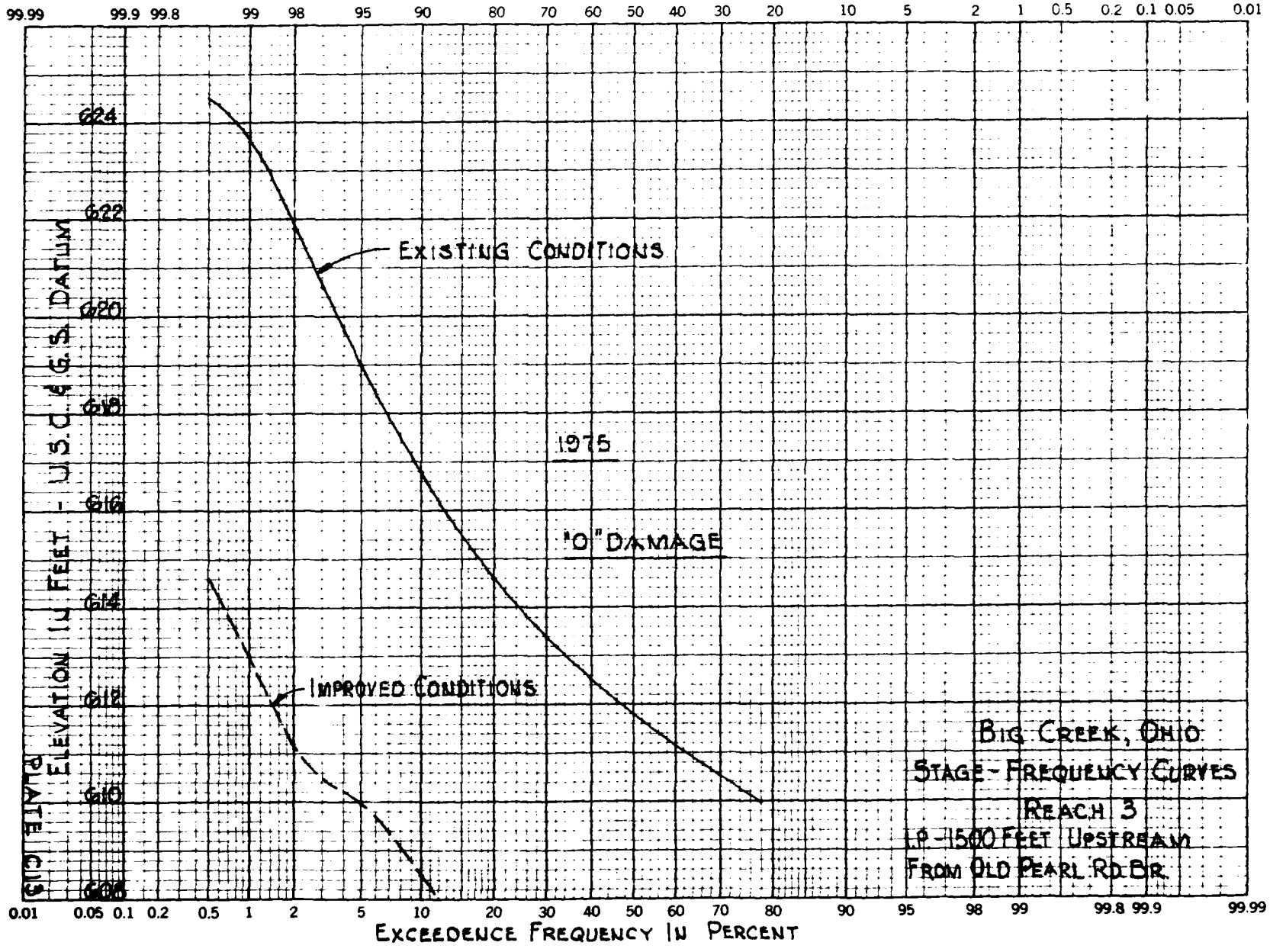
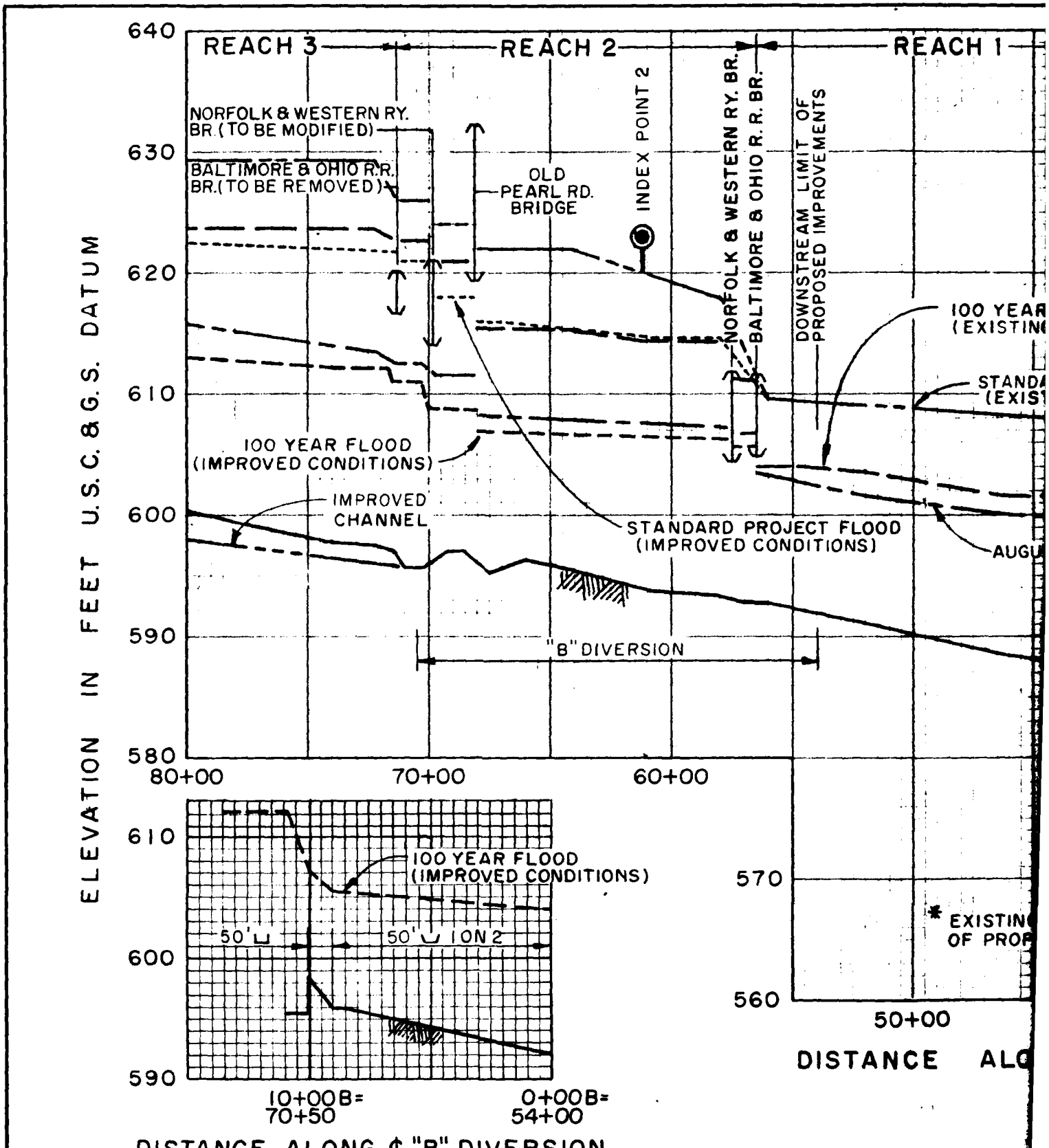
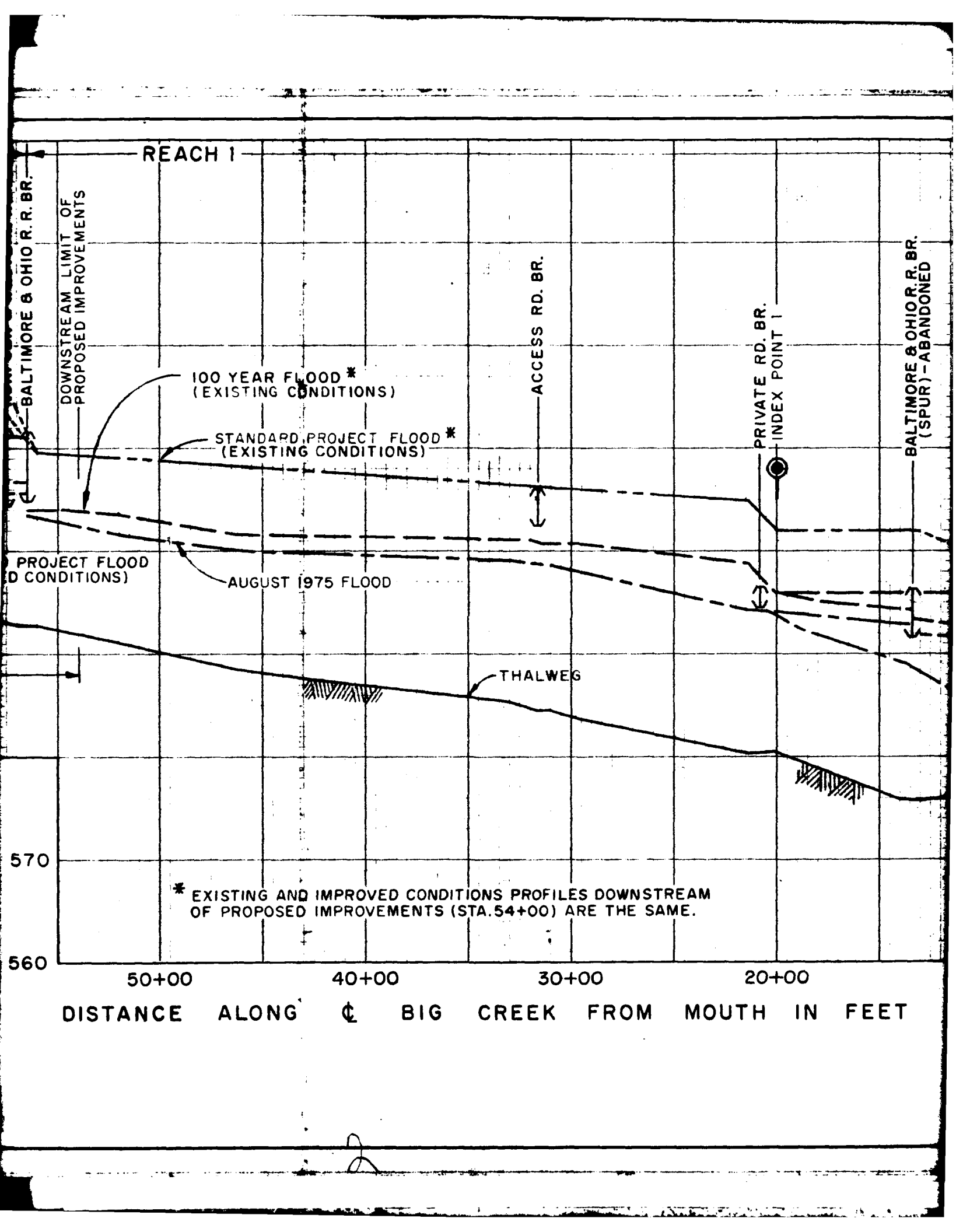
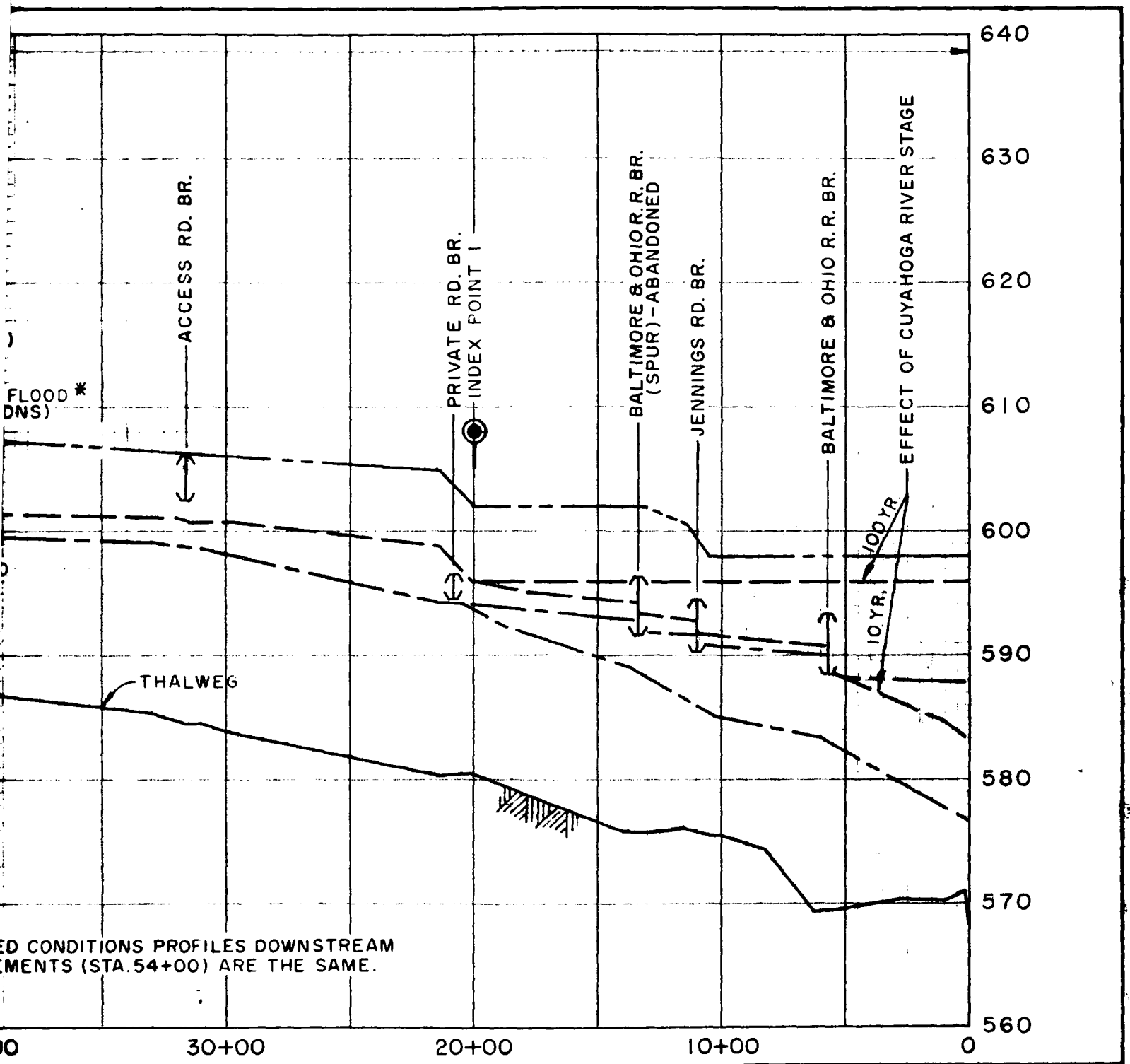


PLATE C15


REACH 3
REACH 2
REACH 1
NORFOLK & WESTERN RY. BR. (TO BE MODIFIED)
BALTIMORE & OHIO R.R. BR. (TO BE REMOVED)
OLD PEARL RD. BRIDGE
INDEX POINT 2
NORFOLK & WESTERN RY. BR.
BALTIMORE & OHIO R.R. BR.
DOWNSTREAM LIMIT OF PROPOSED IMPROVEMENTS
100 YEAR (EXISTING
STANDA (EXIST
100 YEAR FLOOD (IMPROVED CONDITIONS)
IMPROVED CHANNEL
STANDARD PROJECT FLOOD (IMPROVED CONDITIONS)
AUGU
"B" DIVERSION
ELEVATION IN FEET U.S.C.&G.S. DATUM
640
630
620
610
600
590
580
80+00
70+00
60+00
570
560
50+00
* EXISTIN OF PROP
DISTANCE ALO
100 YEAR FLOOD (IMPROVED CONDITIONS)
50' L
50' L ION 2
10+00 B= 70+50
0+00 B= 54+00
DISTANCE ALONG ℄ "B" DIVERSION


REACH 1
BALTIMORE & OHIO R. R. BR.
DOWNSTREAM LIMIT OF PROPOSED IMPROVEMENTS
100 YEAR FLOOD *
(EXISTING CONDITIONS)
STANDARD PROJECT FLOOD *
(EXISTING CONDITIONS)
ACCESS RD. BR.
PRIVATE RD. BR.
INDEX POINT 1
BALTIMORE & OHIO R. R. BR.
(SPUR) - ABANDONED
PROJECT FLOOD
D CONDITIONS)
AUGUST 1975 FLOOD
THALWEG
570
560
* EXISTING AND IMPROVED CONDITIONS PROFILES DOWNSTREAM OF PROPOSED IMPROVEMENTS (STA. 54+00) ARE THE SAME.
50+00
40+00
30+00
20+00
DISTANCE ALONG ℄ BIG CREEK FROM MOUTH IN FEET

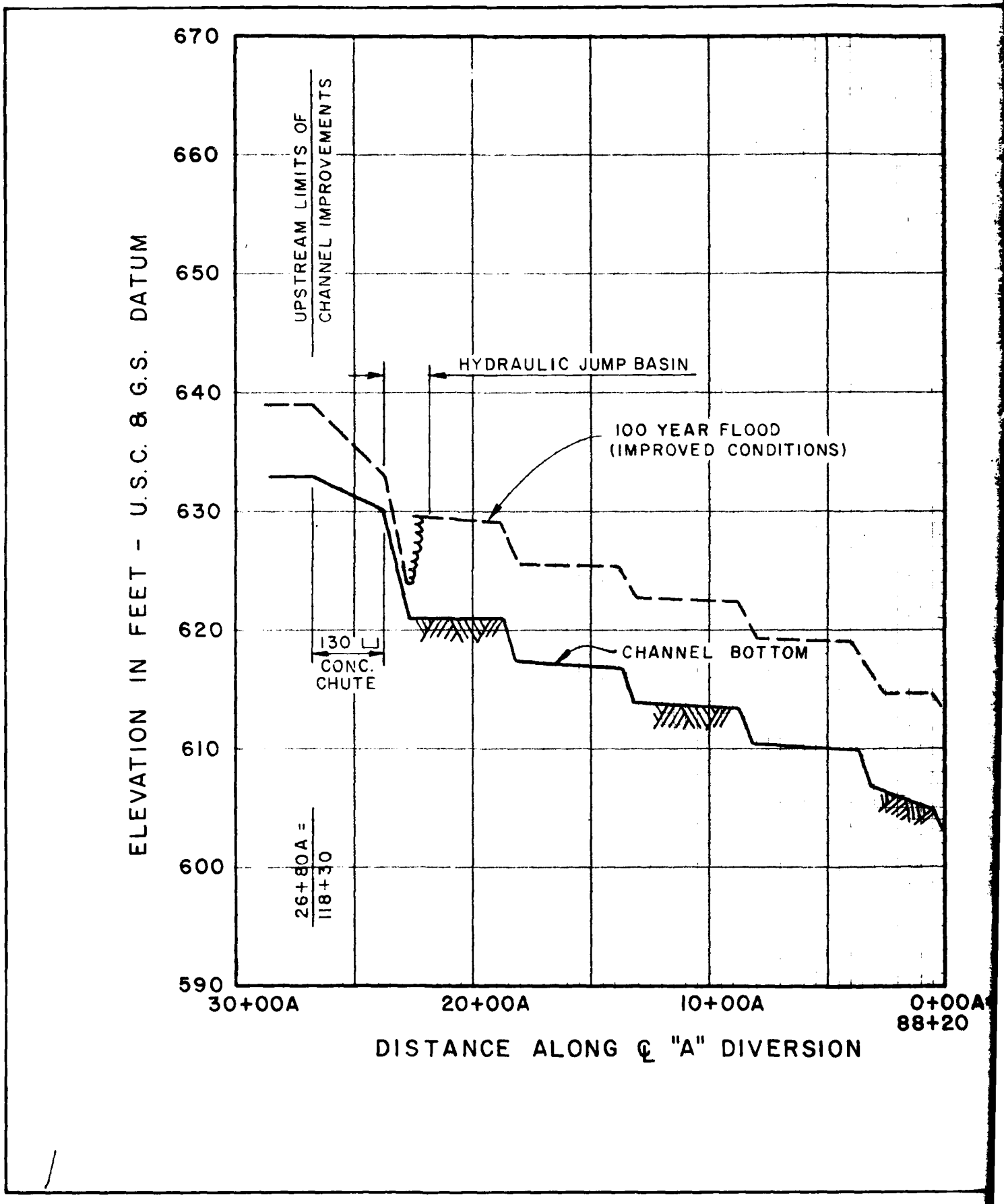


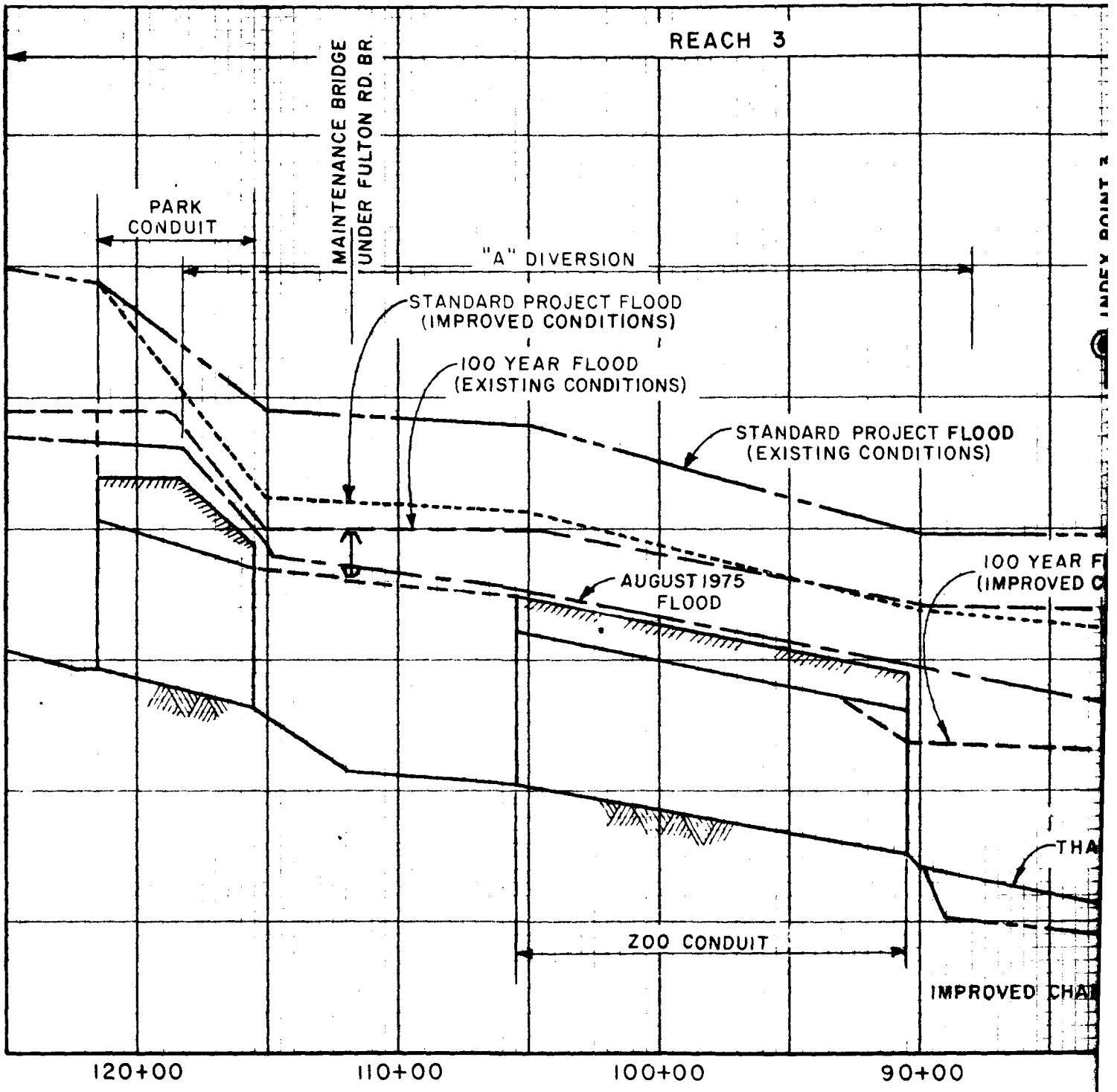
BIG CREEK WATERSHED
CUYAHOGA COUNTY, OHIO

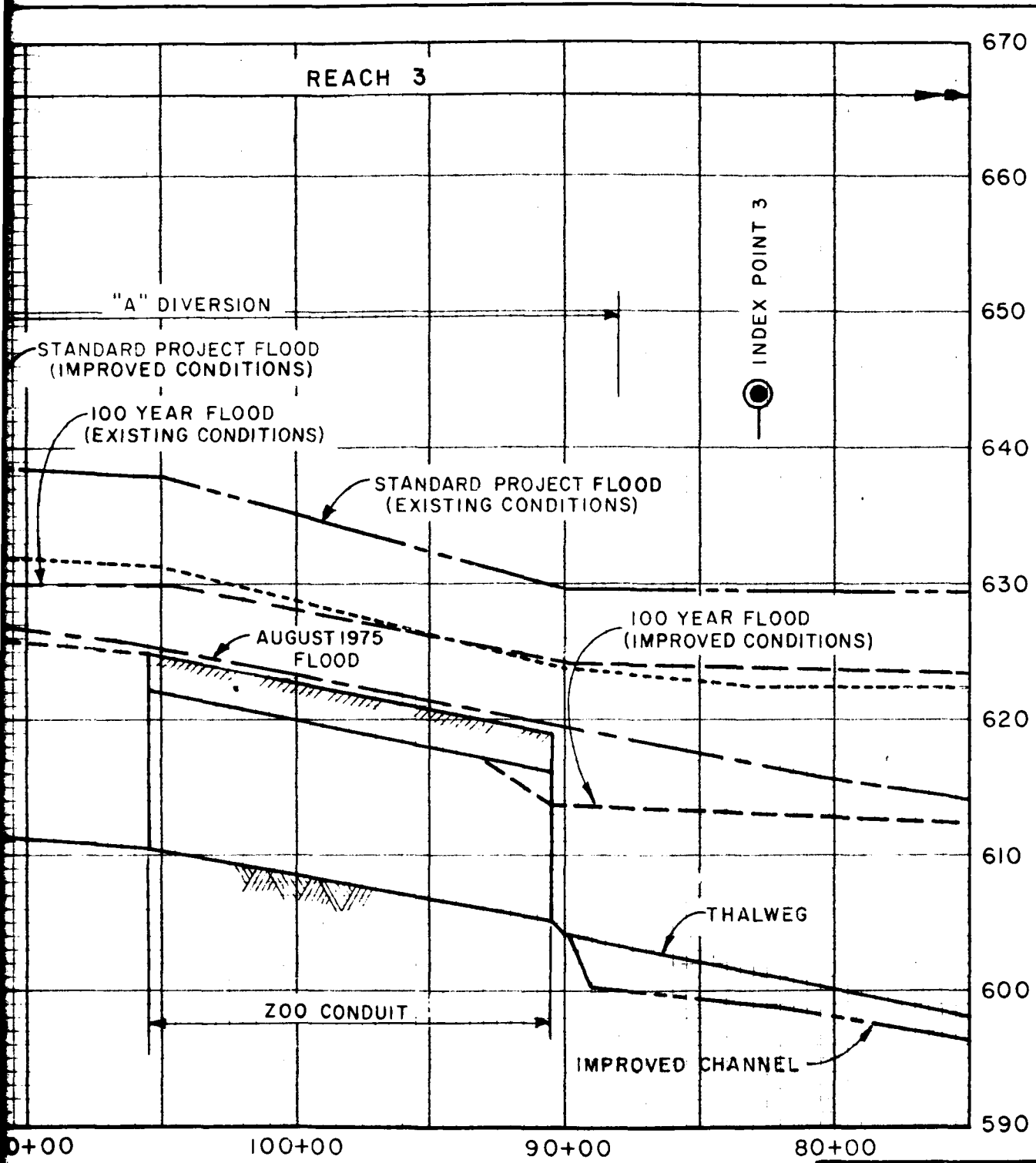
WATER SURFACE PROFILES

U. S. ARMY ENGINEER DISTRICT, BUFFALO
FOR REPORT DATED 1979

PLATE C14


670
660
650
640
630
620
610
600
590
ELEVATION IN FEET - U.S.C. & G.S. DATUM
UPSTREAM LIMITS OF CHANNEL IMPROVEMENTS
HYDRAULIC JUMP BASIN
100 YEAR FLOOD (IMPROVED CONDITIONS)
CHANNEL BOTTOM
130' L CONC. CHUTE
26+80A = 118+30
30+00A
20+00A
10+00A
0+00A
88+20
DISTANCE ALONG ℄ "A" DIVERSION


REACH 3
MAINTENANCE BRIDGE UNDER FULTON RD. BR.
PARK CONDUIT
"A" DIVERSION
STANDARD PROJECT FLOOD (IMPROVED CONDITIONS)
100 YEAR FLOOD (EXISTING CONDITIONS)
STANDARD PROJECT FLOOD (EXISTING CONDITIONS)
AUGUST 1975 FLOOD
100 YEAR F
(IMPROVED C
THA
ZOO CONDUIT
IMPROVED CHA
120+00
110+00
100+00
90+00
DISTANCE ALONG ℄ BIG CREEK FROM MOUTH IN FEE



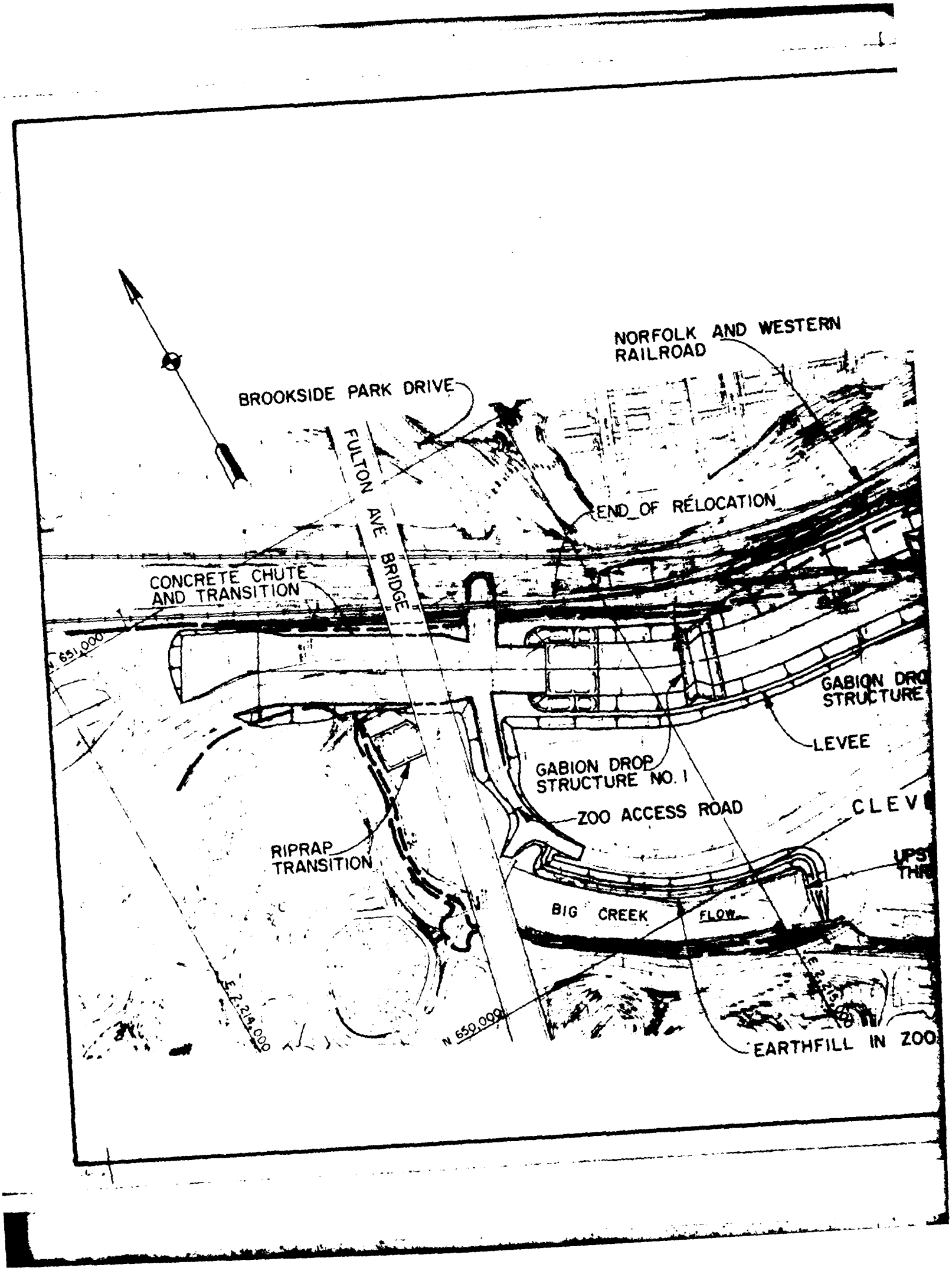
CE ALONG ℄ BIG CREEK FROM MOUTH IN FEET

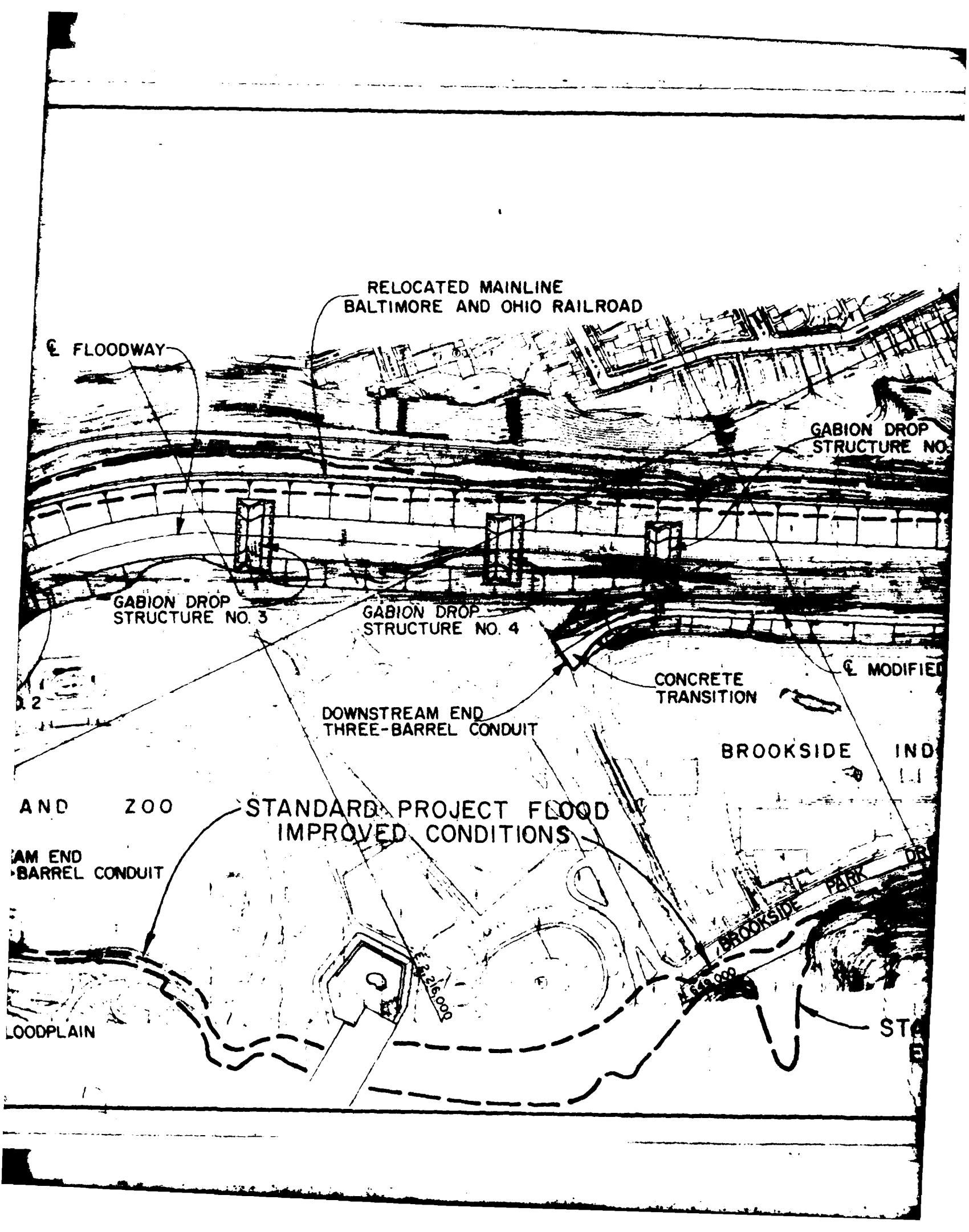
BIG CREEK WATERSHED
CUYAHOGA COUNTY, OHIO

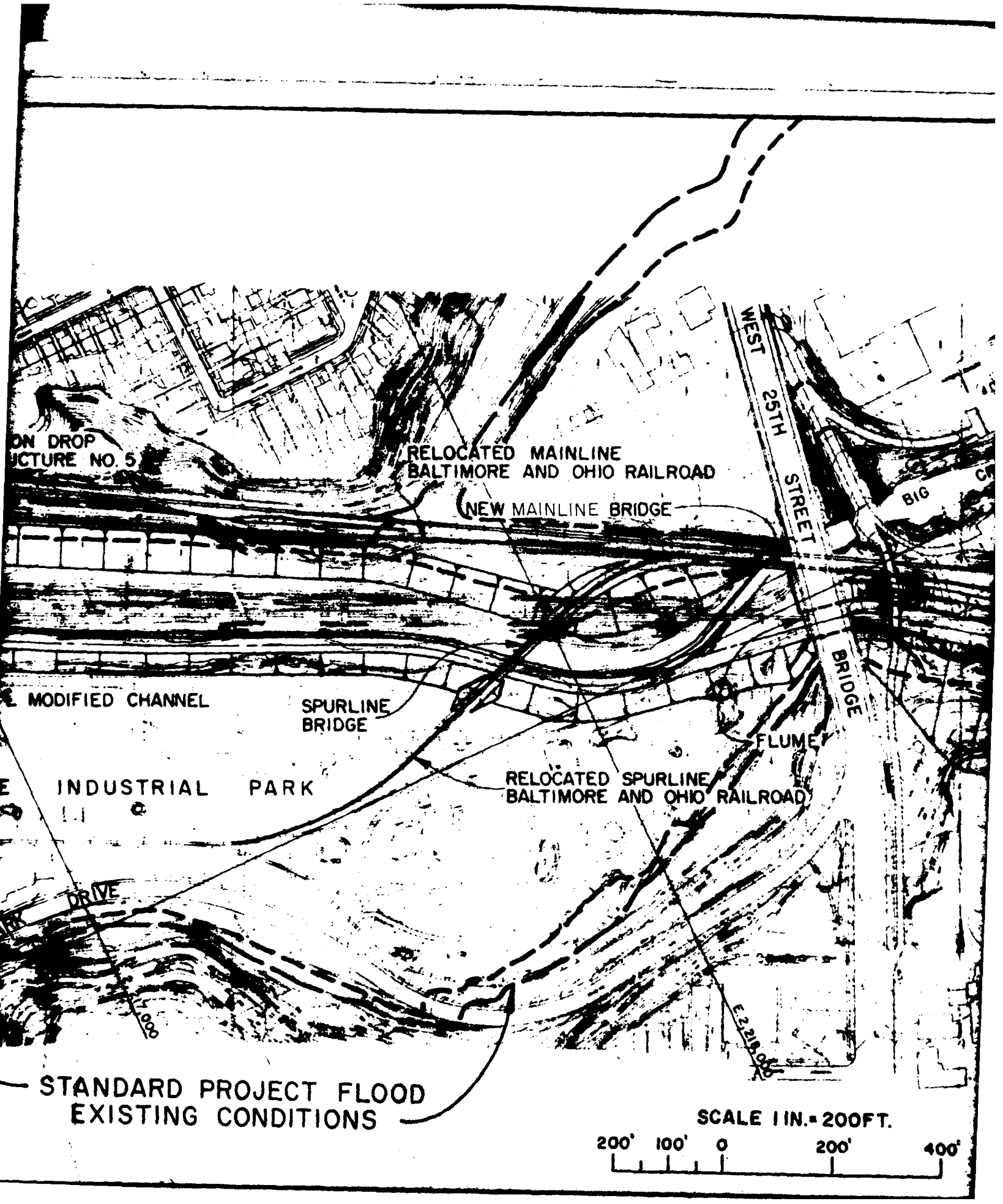
WATER SURFACE PROFILES

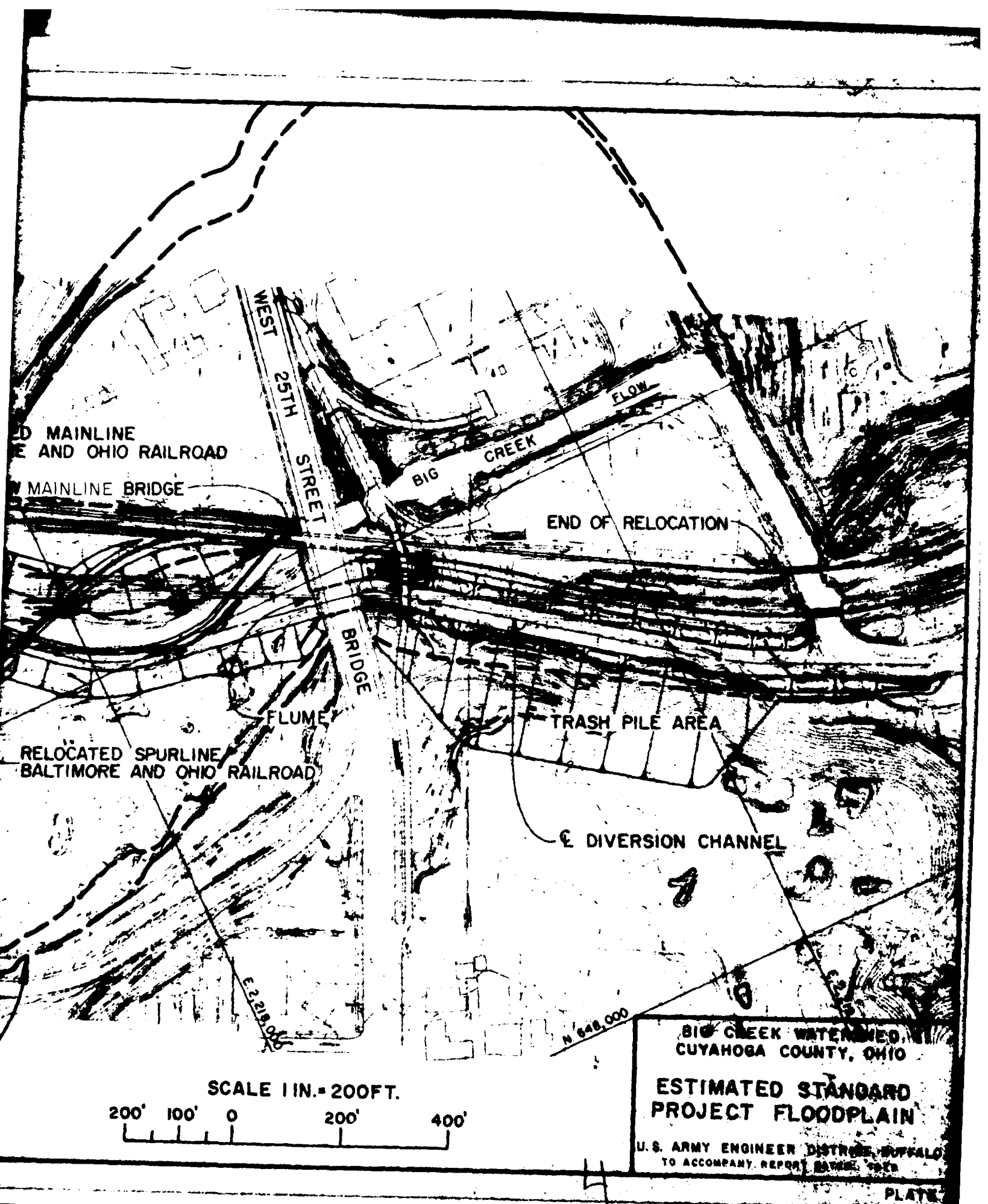
U.S ARMY ENGINEER DISTRICT, BUFFALO
FOR REPORT DATED 1979

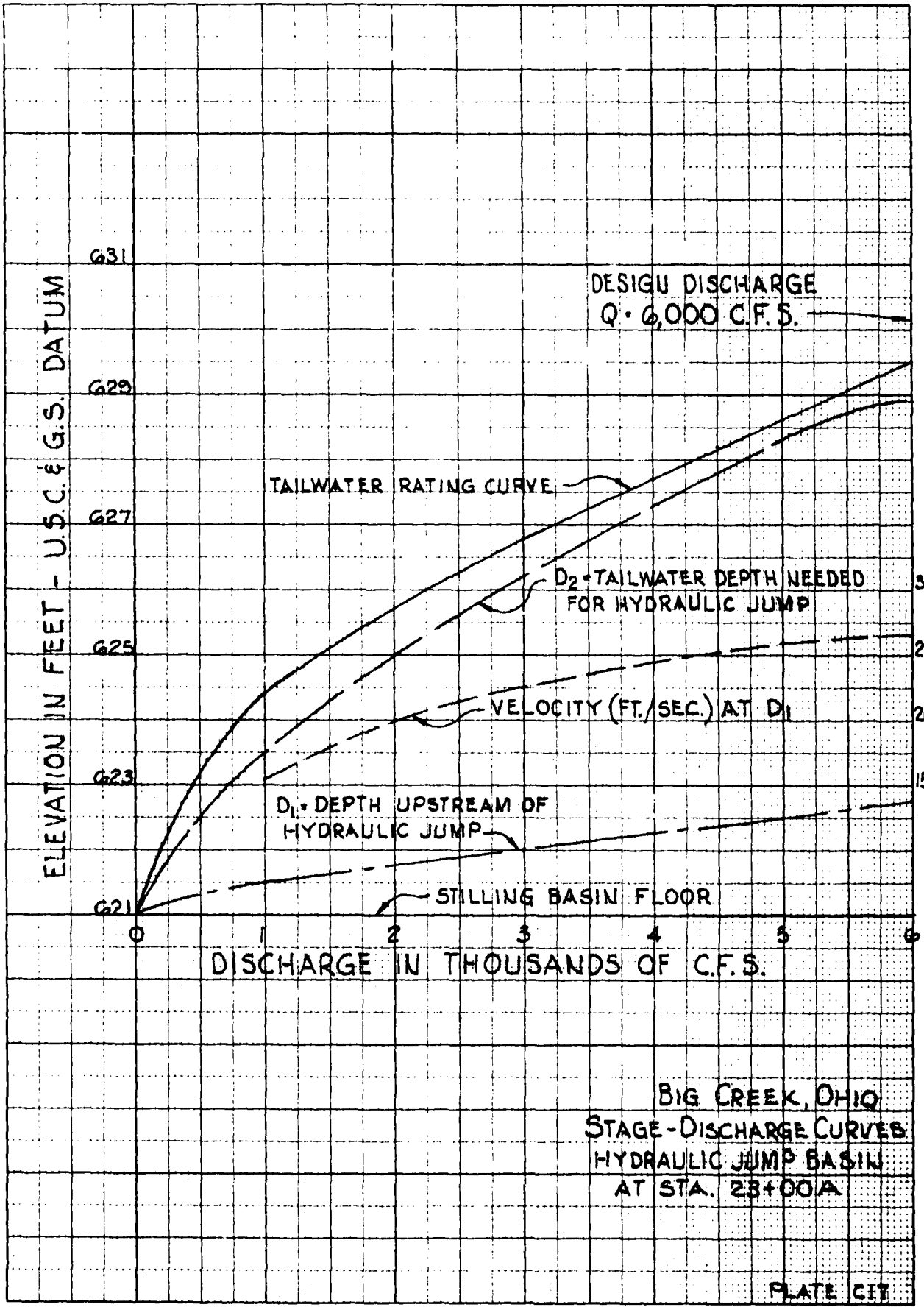
PLATE C15


NORFOLK AND WESTERN
RAILROAD
BROOKSIDE PARK DRIVE
FULTON AVE BRIDGE
END OF RELOCATION
CONCRETE CHUTE
AND TRANSITION
E 651,000
GABION DRO
STRUCTURE
LEVEE
GABION DROP
STRUCTURE NO. 1
ZOO ACCESS ROAD
CLEV
RIPRAP
TRANSITION
BIG CREEK
FLOW
E 2,214,000
N 650,000
E 2,215,00
EARTHFILL IN ZOO


RELOCATED MAINLINE
BALTIMORE AND OHIO RAILROAD
℄ FLOODWAY
GABION DROP
STRUCTURE NO.
GABION DROP
STRUCTURE NO. 3
GABION DROP
STRUCTURE NO. 4
℄ MODIFIED
CONCRETE
TRANSITION
DOWNSTREAM END
THREE-BARREL CONDUIT
BROOKSIDE
IND
AND
ZOO
STANDARD PROJECT FLOOD
IMPROVED CONDITIONS
AM END
BARREL CONDUIT
BROOKSIDE PARK
LOODPLAIN


ON DROP
UCTURE NO. 5
RELOCATED MAINLINE
BALTIMORE AND OHIO RAILROAD
NEW MAINLINE BRIDGE
WEST 25TH STREET
BIG
MODIFIED CHANNEL
SPURLINE
BRIDGE
BRIDGE
FLUME
INDUSTRIAL PARK
RELOCATED SPURLINE
BALTIMORE AND OHIO RAILROAD
DRIVE
E 2,218,000
STANDARD PROJECT FLOOD
EXISTING CONDITIONS
SCALE 1 IN. = 200 FT.
200' 100' 0 200' 400'


D MAINLINE
E AND OHIO RAILROAD
MAINLINE BRIDGE
WEST 25TH STREET
BRIDGE
FLOW
BIG CREEK
END OF RELOCATION
FLUME
TRASH PILE AREA
RELOCATED SPURLINE
BALTIMORE AND OHIO RAILROAD
℄ DIVERSION CHANNEL
E 2,218,000
N 648,000
SCALE 1 IN. = 200 FT.
200' 100' 0 200' 400'
BIG CREEK WATERSHED
CUYAHOGA COUNTY, OHIO
ESTIMATED STANDARD
PROJECT FLOODPLAIN
U.S. ARMY ENGINEER DISTRICT, BUFFALO
TO ACCOMPANY REPORT DATED
PLATE



BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

PHASE II

GENERAL DESIGN MEMORANDUM

APPENDIX E

COST ESTIMATES

Prepared by

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
Consulting Engineers
Harrisburg, Pennsylvania 17105

For

U.S. ARMY ENGINEER DISTRICT, BUFFALO
Corps of Engineers
Buffalo, New York 14207

AUGUST 1979

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

PHASE II

GENERAL DESIGN MEMORANDUM

APPENDIX E

COST ESTIMATES

CONTENTS

TABLES

TABLES (Contd.)

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

PHASE II

GENERAL DESIGN MEMORANDUM

APPENDIX E

COST ESTIMATES

E1. GENERAL. Estimates of costs are based on costs of similar work, by reviewing recent bid prices on channel, levee, and dam projects. Where necessary, the cost estimate is augmented by unit prices adapted from "Building Construction Cost Data 1979", Robert S. Means Company, Inc., and from the "Dodge Guide for Estimating Public Works Construction Projects". All unit prices are adjusted to January 1979 price levels. Generally, Engineering News-Record construction cost indices are used for escalating unit prices. However, a considerable amount of engineering judgment is necessary in order to reflect specific site conditions. Costs for engineering, design, supervision and administration are based on costs of accomplishing similar work. A summary of project costs is presented in Table E1.

E2. FEDERAL COSTS. An itemized construction cost estimate for the Federal share of the project is presented in this Appendix. The costs for constructing the railroad relocations is presented in Tables E2 and E3. Table E2 presents the itemized costs for constructing the trackwork. Table E3 presents the itemized costs for constructing the railroad bridges and temporary trestle. The itemized cost estimate for relocating utilities and demolishing structures is presented in Table E4. The costs of the channel work, which includes the floodway, modified, and diversion channels, as well as other items, is presented in Table E6.

E3. NON-FEDERAL COSTS. The itemized cost estimate for work to be accomplished by local interests is presented in Table E5. The cost for the CEI utility relocations was supplied by CEI. The property acquisition costs are computed on a per acre basis, using estimates from the Cleveland area for similar sites.

TABLE E1

SUMMARY OF FEDERAL AND NON-FEDERAL COSTS

FEDERAL COSTS	
Railroad Relocations (Trackwork)	$ 1,845,000
Railroad Relocations (Bridges)	1,021,000
Relocations (Utilities and Demolition of Structures)	1,803,900
Floodway, Modified, and Diversion Channels	6,904,000
Total Construction Cost	$11,573,900
Engineering and Design (11%±)	1,273,100
Supervision and Administration (9%±)	1,042,000
TOTAL FEDERAL COSTS	**$13,889,000**
NON-FEDERAL COSTS	
Property	$ 348,660
Property Acquisition Cost (10%±)	35,340
Total Property Cost	$ 384,000
Relocations (Utilities)	$ 235,000
Engineering and Design (11%±)	$ 26,000
Supervision and Administration (9%±)	$ 21,000
Total Relocations (Utilities)	$ 282,000
TOTAL NON-FEDERAL COSTS	**$ 666,000**
SUMMARY	
FEDERAL COSTS	$13,889,000
NON-FEDERAL COSTS	666,000
TOTAL COST	$14,555,000

TABLE E2

CONSTRUCTION COST ESTIMATE

FEDERAL COSTS FOR RELOCATIONS

RAILROAD RELOCATIONS - TRACKWORK

Description	Quantity	Unit	Unit Price	Amount
Stripping	13,800	C.Y.	$ 3.00	$ 41,400
Borrow Excavation	110,000	C.Y.	$ 6.00	$ 660,000
Rolled Earthfill	124,000	C.Y.	$ 1.20	$ 148,800
Bridge Removal	-	Job	L.S.	$ 18,000
Sub-Ballast	3,610	C.Y.	$ 10.30	$ 37,183
Ballast	3,700	C.Y.	$ 9.25	$ 34,225
Trackwork:				
Class A	4,720	L.F.	$ 90.00	$ 424,800
Class B	1,030	L.F.	$ 73.00	$ 75,190
Structures	330	L.F.	$ 90.00	$ 29,700
Guardrail	800	L.F.	$ 2.25	$ 1,800
Turnout, 16'6" - No. 8	2	Ea.	$22,000.00	$ 44,000
Track Removal	5,850	L.F.	$ 12.50	$ 73,125
Track Realignment	-	Job	L.S.	$ 6,000
Track Adjustment	460	L.F.	$ 17.50	$ 8,050
Switch Stands	2	Ea.	$ 550.00	$ 1,100
Inlets	1	Ea.	$ 600.00	$ 600
18-inch dia. RCP, Class IV	36	L.F.	$ 11.00	$ 396
Subtotal				$1,604,369
Contingencies (15%*)				240,631
TOTAL FEDERAL COST, RAILROAD RELOCATIONS - TRACKWORK				$1,845,000

TABLE E3

CONSTRUCTION COST ESTIMATE

FEDERAL COSTS FOR RELOCATIONS

RAILROAD RELOCATIONS - BRIDGES

Description	Quantity	Unit	Unit Price	Amount
BALTIMORE AND OHIO RAILROAD MAINLINE BRIDGE NO. 108				
Common Excavation	2,850	C.Y.	$ 4.00	$ 11,400
Rock Excavation, Structural	650	C.Y.	$ 15.00	$ 9,750
Compacted Backfill	3,220	C.Y.	$ 20.00	$ 64,400
Concrete	827	C.Y.	$150.00	$124,050
Portland Cement	4,300	Cwt.	$ 6.00	$ 25,800
Reinforcing Steel	66,200	Lb.	$ 0.45	$ 29,790
Structural Steel	107,600	Lb.	$ 0.75	$ 80,700
Lumber	1.03	Mbfm.	$600.00	$ 618
Ties:				
9" x 9" x 10'0"	70	Ea.	$ 34.00	$ 2,380
9" x 9" x 14'6"	35	Ea.	$ 45.00	$ 1,575
Pipe-Concrete:				
8-inch dia. porous	128	L.F.	$ 8.00	$ 1,024
8-inch dia. plain	20	L.F.	$ 8.00	$ 160
Subtotal				$351,647
Contingencies (15%±)				52,753
TOTAL				$404,400

TABLE E3 (Contd.)

CONSTRUCTION COST ESTIMATE

FEDERAL COSTS FOR RELOCATIONS

RAILROAD RELOCATIONS - BRIDGES

Description	Quantity	Unit	Unit Price	Amount
BALTIMORE AND OHIO RAILROAD SPURLINE BRIDGE NO. 108/1				
Common Excavation	550	C.Y.	$ 4.00	$ 2,200
Rock Excavation, Structural	670	C.Y.	$ 15.00	$ 10,050
Compacted Backfill	2,010	C.Y.	$ 20.00	$ 40,200
Concrete	929	C.Y.	$150.00	$139,350
Portland Cement	4,800	Cwt.	$ 6.00	$ 28,800
Reinforcing Steel	74,400	Lb.	$ 0.45	$ 33,480
Structural Steel	217,300	Lb.	$ 0.75	$162,975
Lumber	1.83	Mbfm.	$600.00	$ 1,098
Ties:				
9" x 9" x 10'0"	81	Ea.	$ 34 00	$ 2,754
9" x 9" x 14'6"	45	Ea.	$ 45.00	$ 2,025
Pipe-Concrete:				
8-inch dia. porous	137	L.F.	$ 8.00	$ 1,096
8-inch dia. plain	18	L.F.	$ 8.00	$ 144
Subtotal				$424,172
Contingencies (15%±)				63,628
TOTAL				$487,800

TABLE E3 (Contd.)

CONSTRUCTION COST ESTIMATE

FEDERAL COSTS FOR RELOCATIONS

RAILROAD RELOCATIONS - BRIDGES

Description	Quantity	Unit	Unit Price	Amount
NORFOLK AND WESTERN RAILROAD TEMPORARY TRESTLE				
Lumber	9.55	Mbfm.	$600.00	$ 5,730
Ties:				
9" x 9" x 10'0"	69	Ea.	$ 34.00	$ 2,346
9" x 9" x 14'6"	35	Ea.	$ 45.00	$ 1,575
Structural Steel	86,160	Lb.	$ 1.00	$ 86,160
Steel H-Piles	324	L.F.	$ 50.00	$ 16,200
Subtotal				$112,011
Contingencies (15%±)				16,789
TOTAL				$128,800

SUMMARY

Baltimore and Ohio Railroad Mainline Bridge	$ 404,400
Baltimore and Ohio Railroad Spurline Bridge	487,800
Norfolk and Western Railroad Temporary Trestle	128,800
TOTAL FEDERAL COST, RAILROAD RELOCATIONS - BRIDGES	$1,021,000

TABLE E4

CONSTRUCTION COST ESTIMATE

FEDERAL COSTS FOR RELOCATIONS

UTILITIES AND DEMOLITION OF STRUCTURES

Description	Quantity	Unit	Unit Price	Amount
DEMOLITION OF STRUCTURES:				
1. Bridge near Station 68+00D	-	Job	L.S.	$ 6,000
2. Building near Station 115+00F	-	Job	L.S.	$ 1,000
3. Building near Station 112+00F	-	Job	L.S.	$ 1,600
4. Building near Station 110+50F	-	Job	L.S.	$ 2,400
5. Building near Station 109+00F	-	Job	L.S.	$ 2,600
Subtotal				$ 13,600
Contingencies (15%±)				2,000
TOTAL - DEMOLITION OF STRUCTURES				$ 15,600

TABLE E4 (Contd.)

CONSTRUCTION COST ESTIMATE

FEDERAL COSTS FOR RELOCATIONS

UTILITIES AND DEMOLITION OF STRUCTURES

Description	Quantity	Unit	Unit Price	Amount
UTILITY RELOCATIONS:				
Electric Lines:				
1. Street Lamps at Chute-Transition	-	Job	L.S.	$ 7,100
2. Underground 15 KV Line near Station 114+00F	-	Job	L.S.	$ 4,700
3. Underground Duct Bank near Station 68+00D:				
Common Excavation	720	C.Y.	$ 6.00	$ 4,320
Rock Excavation	580	C.Y.	$ 30.00	$ 17,400
Backfill	240	C.Y.	$ 10.00	$ 2,400
Concrete Backfill	45	C.Y.	$ 100.00	$ 4,500
Shoring - left-in-place	2,090	S.F.	$ 10.00	$ 20,900
Shoring - removed	1,340	S.F.	$ 4.50	$ 6,030
Jacking Pipe in Soil	30	L.F.	$ 300.00	$ 9,000
Augering Pipe in Rock	110	L.F.	$ 450.00	$ 49,500
30-Inch Casing Pipe	180	L.F.	$ 50.00	$ 9,000

TABLE E4 (Contd.)

CONSTRUCTION COST ESTIMATE

FEDERAL COSTS FOR RELOCATIONS

UTILITIES AND DEMOLITION OF STRUCTURES

Description	Quantity	Unit	Unit Price	Amount
UTILITY RELOCATIONS:				
Electric Lines:				
3. Underground Duct Bank near Station 68+00D: (Contd.)				
Manholes:				
Concrete	200	C.Y.	$ 350.00	$ 70,000
Precast	1	Ea.	$1,190.00	$ 1,190
Covers	3	Ea.	$ 160.00	$ 480
Electric Sump System	2	Ea.	$ 500.00	$ 1,000
4-Inch Duct Bank	6,880	L.F.	$ 8.00	$ 55,040
15 KV 3/c No. 1 Conductor	6,880	L.F.	$ 10.00	$ 68,800
Subtotal - Duct Bank				$319,560
Subtotal - Electric Lines				331,360
Contingencies (15%±)				49,640
TOTAL - Electric Lines				$381,000

TABLE E4 (Contd.)

CONSTRUCTION COST ESTIMATE

FEDERAL COSTS FOR RELOCATIONS

UTILITIES AND DEMOLITION OF STRUCTURES

Description	Quantity	Unit	Unit Price	Amount
UTILITY RELOCATIONS:				
Sanitary Sewers:				
1. Extension of 8-Inch CIP near Station 90+00M	-	Job	L.S.	$ 760
2. 4-Inch CIP near Station 98+00F:				
Common Excavation	480	C.Y.	$ 6.00	$ 2,880
Backfill	380	C.Y.	$ 10.00	$ 3,800
Gravel Backfill	70	C.Y.	$ 20.00	$ 1,400
Concrete Backfill	30	C.Y.	$ 100.00	$ 3,000
Shoring	6,500	S.F.	$ 4.50	$ 29,250
Jacking Pipe in Soil	40	L.F.	$ 200.00	$ 8,000
Augering Pipe in Rock	100	L.F.	$ 325.00	$ 32,500
4-Inch CIP	530	L.F.	$ 8.00	$ 4,240
24-Inch Casing Pipe	380	L.F.	$ 40.00	$ 15,200

TABLE E4 (Contd.)

CONSTRUCTION COST ESTIMATE

FEDERAL COSTS FOR RELOCATIONS

UTILITIES AND DEMOLITION OF STRUCTURES

Description	Quantity	Unit	Unit Price	Amount
UTILITY RELOCATIONS:				
Sanitary Sewers:				
2. 4-Inch CIP near Station 98+00F: (Contd.)				
Manholes - Precast:				
6 feet deep	1	Ea.	$ 960.00	$ 960
7 feet deep	2	Ea.	$1,020.00	$ 2,040
14 feet deep	2	Ea.	$2,470.00	$ 4,940
Subtotal - 4-Inch CIP				$108,210

TABLE E4 (Contd.)

CONSTRUCTION COST ESTIMATE

FEDERAL COSTS FOR RELOCATIONS

UTILITIES AND DEMOLITION OF STRUCTURES

Description	Quantity	Unit	Unit Price	Amount
UTILITY RELOCATIONS:				
Sanitary Sewers:				
3. 48-Inch Line on Right Bank near Flume:				
Common Excavation	2,970	C.Y.	$ 6.00	$ 17,820
Compacted Backfill	2,880	C.Y.	$ 10.00	$ 28,800
Sheeting and Shoring	22,945	S.F.	$ 4.50	$103,250
Concrete - Headwall	15	C.Y.	$ 250.00	$ 3,750
Concrete - Manholes	214	C.Y.	$ 350.00	$ 74,900
Precast Manhole	1	Ea.	$1,100.00	$ 1,100
Manhole Cover and Top	3	Ea.	$ 250.00	$ 750
48-Inch RCP	405	L.F.	$ 45.00	$ 18,230
Subtotal - 48-Inch Line				$248,600
Subtotal - Sanitary Sewers				357,570
Contingencies (15%±)				53,630
TOTAL - Sanitary Sewers				$411,200

E1.

TABLE E4 (Contd.)

CONSTRUCTION COST ESTIMATE

FEDERAL COSTS FOR RELOCATIONS

UTILITIES AND DEMOLITION OF STRUCTURES

Description	Quantity	Unit	Unit Price	Amount
UTILITY RELOCATIONS:				
Storm Sewers:				
1. 24-Inch VCP near Station 75+00M	-	Job	L.S.	$ 6,500
2. 8-Inch VCP near Station 86+50M	-	Job	L.S.	$ 1,900
Subtotal - Storm Sewers				$ 8,400
Contingencies (15%±)				1,300
TOTAL - Storm Sewers				$ 9,700

TABLE E4 (Contd.)

CONSTRUCTION COST ESTIMATE

FEDERAL COSTS FOR RELOCATIONS

UTILITIES AND DEMOLITION OF STRUCTURES

Description	Quantity	Unit	Unit Price	Amount
UTILITY RELOCATIONS:				
Waterlines:				
1. 20-Inch Line near Station 68+00D:				
Common Excavation	510	C.Y.	$ 6.00	$ 3,060
Rock Excavation	610	C.Y.	$ 30.00	$ 18,300
Backfill	100	C.Y.	$ 10.00	$ 1,000
Concrete Backfill	90	C.Y.	$ 100.00	$ 9,000
Shoring - left-in-place	2,090	S.F.	$ 10.00	$ 20,900
Shoring - removed	1,340	S.F.	$ 4.50	$ 6,030
Jacking Pipe in Soil	30	L.F.	$ 300.00	$ 9,000
Augering Pipe in Rock	110	L.F.	$ 450.00	$ 49,500
30-Inch Casing Pipe	180	L.F.	$ 50.00	$ 9,000
20-Inch CIP	270	L.F.	$ 40.00	$ 10,800
20-Inch Valves	4	Ea.	$3,000.00	$ 12,000
Manholes:				
Concrete	200	C.Y.	$ 350.00	$ 70,000
Precast - 6 feet deep	1	Ea.	$ 960.00	$ 960
Valve Pits	3	Ea.	$1,200.00	$ 3,600

TABLE E4 (Contd.)

CONSTRUCTION COST ESTIMATE

FEDERAL COSTS FOR RELOCATIONS

UTILITIES AND DEMOLITION OF STRUCTURES

Description	Quantity	Unit	Unit Price	Amount
UTILITY RELOCATIONS:				
Waterlines:				
1. 20-Inch Line near Station 68+00D: (Contd.)				
Electric Sump System	2	Ea.	$ 500.00	$ 1,000
Subtotal - 20-Inch Line				$224,150
2. 8-Inch Waterline at Chute-Transition:				
Common Excavation	1,100	C.Y.	$ 6.00	$ 6,600
Backfill	650	C.Y.	$ 10.00	$ 6,500
Gravel Backfill	190	C.Y.	$ 20.00	$ 3,800
Concrete Backfill	210	C.Y.	$ 100.00	$ 21,000
Shoring - left-in-place	6,100	S.F.	$ 3.30	$ 20,130
Shoring - to remain	10,000	S.F.	$ 3.00	$ 30,000
Valve Pits	3	Ea.	$1,200.00	$ 3,600

TABLE E4 (Contd.)

CONSTRUCTION COST ESTIMATE

FEDERAL COSTS FOR RELOCATIONS

UTILITIES AND DEMOLITION OF STRUCTURES

Description	Quantity	Unit	Unit Price	Amount
UTILITY RELOCATIONS:				
Waterlines:				
2. 8-Inch Waterline at Chute-Transition: (Contd.)				
8-Inch CIP	1,640	L.F.	$ 13.00	$ 21,320
8-Inch Valves	5	Ea.	$ 600.00	$ 3,000
Subtotal - 8-Inch Line				$115,950
Subtotal - Waterlines				340,100
Contingencies (15%±)				51,000
TOTAL - Waterlines				$391,100

TABLE E4 (Contd.)

CONSTRUCTION COST ESTIMATE

FEDERAL COSTS FOR RELOCATIONS

UTILITIES AND DEMOLITION OF STRUCTURES

Description	Quantity	Unit	Unit Price	Amount
UTILITY RELOCATIONS:				
Gas Lines:				
1. 8-Inch Line near Station 68+00D:				
Common Excavation	430	C.Y.	$ 6.00	$ 2,580
Rock Excavation	510	C.Y.	$ 30.00	$ 15,300
Compacted Backfill	80	C.Y.	$ 10.00	$ 800
Shoring - left-in-place	2,090	S.F.	$ 10.00	$ 20,900
Shoring - pulled	1,340	S.F.	$ 4.50	$ 6,030
Pump System	2	Ea.	$ 500.00	$ 1,000
Valve Pits	2	Ea.	$1,000.00	$ 2,000
Concrete - Manholes	200	C.Y.	$ 350.00	$ 70,000
Concrete - Backfill	75	C.Y.	$ 100.00	$ 7,500
Jacking Pipe	30	L.F.	$ 250.00	$ 7,500
Augering Pipe	110	L.F.	$ 400.00	$ 44,000
Pipe:				
24-Inch Casing	180	L.F.	$ 40.00	$ 7,200
8-Inch CIP	270	L.F.	$ 20.00	$ 5,400
8-Inch Valves	4	Ea.	$1,500.00	$ 6,000
Subtotal - Gas Lines				$196,210
Contingencies (15%±)				29,390
TOTAL - Gas Lines				$225,600

(Contd.)

TABLE E4

CONSTRUCTION COST ESTIMATE

FEDERAL COSTS FOR RELOCATIONS

UTILITIES AND DEMOLITION OF STRUCTURES

Description	Quantity	Unit	Unit Price	Amount
UTILITY RELOCATIONS:				
Telephone Lines:				
1. Line Crossing near Station 67+75D:				
Common Excavation	1,220	C.Y.	$ 6.00	$ 7,320
Rock Excavation	1,390	C.Y.	$ 30.00	$ 41,700
Tunnel Excavation	91	C.Y.	$ 600.00	$ 54,600
Compacted Backfill	2,270	C.Y.	$ 10.00	$ 22,700
Sheeting and Shoring	4,120	S.F.	$ 4.50	$ 18,540
Jacking Pipe	30	L.F.	$ 500.00	$ 15,000
Precast Manholes	3	Ea.	$2,500.00	$ 7,500
Manhole Covers	5	Ea.	$ 250.00	$ 1,250
Concrete - Manhole	220	C.Y.	$ 350.00	$ 77,000
Grout	15	C.Y.	$ 50.00	$ 750
Pipe:				
80-Inch Diameter Steel	80	L.F.	$ 180.00	$ 14,400
66-Inch Diameter CMP	80	L.F.	$ 60.00	$ 4,800
66-Inch Diameter RCP	275	L.F.	$ 100.00	$ 27,500
Duct	2,840	L.F.	$ 10.00	$ 28,400
Subtotal - Telephone Lines				$321,460
Contingencies (15%±)				48,240
TOTAL - Telephone Lines				$369,700

(Contd.)

TABLE E4

CONSTRUCTION COST ESTIMATE

FEDERAL COSTS FOR RELOCATIONS

UTILITIES AND DEMOLITION OF STRUCTURES

SUMMARY:

Demolition of Structures	$ 15,600
Electric Lines	381,000
Sanitary Sewerlines	411,200
Storm Sewers	9,700
Waterlines	391,100
Gas Lines	225,600
Telephone Lines	369,700
TOTAL FEDERAL COSTS, UTILITIES AND DEMOLITION OF STRUCTURES	$1,803,900

TABLE E5

CONSTRUCTION COST ESTIMATE

NON-FEDERAL COSTS
FOR
PROPERTY AND UTILITY RELOCATIONS

PROPERTY	
Temporary Easement: 10 Acres @ $1,170/Acre	$ 11,700
Permanent Easement: 36 Acres @ $9,360/Acre	336,960
Total	$348,660
RELOCATIONS (UTILITIES)	
Cleveland Electric Illuminating (CEI):	
Guy Wires and Concrete Anchors for Power Pole (Lump Sum)	$ 40,000*
CEI Overhead Electrical System crossing near Station 68+00D and extending down the B&O Railroad Tracks (Lump Sum)	150,000*
City of Cleveland (Muny)	
Overhead Electric Line crossing near Station 114+00F (Lump Sum)	5,700
Muny Overhead Electric Line extending between Station 114+00F and Station 106+00F (Lump Sum)	8,300
Subtotal	$204,000
Contingencies (15%±)	31,000
Total	$235,000
SUMMARY	
PROPERTY	$348,660
RELOCATIONS (UTILITIES)	235,000
TOTAL NON-FEDERAL COST, PROPERTY AND RELOCATIONS (UTILITIES)	$583,660

* Cost estimate obtained from CEI.

TABLE E6

CONSTRUCTION COST ESTIMATE

FEDERAL COSTS FOR FLOODWAY, MODIFIED, AND DIVERSION CHANNELS

Description	Quantity	Unit	Unit Price	Amount
Diversion and Care of Water	-	Job	L.S.	$ 50,000
Clearing and Grubbing	17	Acre	$2,500.00	$ 42,500
Stripping	4,400	C.Y.	$ 3.00	$ 13,200
Common Excavation	360,000	C.Y.	$ 4.00	$1,440,000
Rock Excavation	27,200	C.Y.	$ 5.00	$ 136,000
Rock Excavation, Structural	43,400	C.Y.	$ 15.00	$ 651,000
Rolled Earthfill, Levee	9,400	C.Y.	$ 1.50	$ 14,100
Rolled Earthfill, Zoo Access Road	3,500	C.Y.	$ 1.50	$ 5,250
Rolled Earthfill, Zoo Flood Plain	1,900	C.Y.	$ 1.50	$ 2,850
Compacted Earthfill	6,250	C.Y.	$ 1.50	$ 9,375
Compacted Earthfill, Channel Bottom	10,100	C.Y.	$ 3.00	$ 30,300
Compacted Earthfill, Trash Pile	14,800	C.Y.	$ 6.00	$ 88,800
Compacted Backfill	7,500	C.Y.	$ 10.00	$ 75,000
Spoiling	310,000	C.Y.	$ 1.60	$ 496,000
12-Inch Riprap	4,850	C.Y.	$ 45.00	$ 218,250
18-Inch Riprap	1,150	C.Y.	$ 45.00	$ 51,750
12-Inch Gabion	2,500	C.Y.	$ 80.00	$ 200,000
Gabion Keys	830	C.Y.	$ 70.00	$ 58,100
6-Inch Bedding Material	4,500	C.Y.	$ 22.00	$ 99,000
			Total This Page -	$3,681,475

TABLE E6 (Contd.)

CONSTRUCTION COST ESTIMATE

FEDERAL COSTS FOR FLOODWAY, MODIFIED, AND DIVERSION CHANNELS

Description	Quantity	Unit	Unit Price	Amount
Rock Spall	160	C.Y.	$ 20.00	$ 3,200
Filter Material	2,100	C.Y.	$ 22.00	$ 46,200
Gravel Drain	2,300	C.Y.	$ 20.00	$ 46,000
Foundation Preparation	170	Sqs.	$ 150.00	$ 25,500
Concrete, Chute Transition	5,100	C.Y.	$ 150.00	$ 765,000
Concrete, Transition @ 3-Barrel Conduit	450	C.Y.	$ 180.00	$ 81,000
Concrete, Diversion Channel Flume	2,600	C.Y.	$ 180.00	$ 468,000
Concrete, Backfill	400	C.Y.	$ 100.00	$ 40,000
Portland Cement	44,000	Cwt.	$ 6.00	$ 264,000
Steel Reinforcement	590,000	Lbs.	$ 0.45	$ 265,500
Rubber Waterstop	7,400	L.F.	$ 10.00	$ 74,000
Drilling 3-Inch Dia. Holes and Grouting Anchors in Rock	110	L.F.	$ 15.00	$ 1,650
Drilling 3-Inch Dia. Drain Holes	600	L.F.	$ 15.00	$ 9,000
Pipe:				
(a) 6-Inch Dia. Perforated VCP	2,600	L.F.	$ 7.00	$ 18,200
(b) 12-Inch Dia. Perforated VCP	210	L.F.	$ 13.00	$ 2,730
(c) 12-Inch Dia. Outlet VCP	100	L.F.	$ 10.00	$ 1,000
(d) 18-Inch Dia. RCP	300	L.F.	$ 30.00	$ 9,000
(e) 6-Inch Dia. Asbestos	70	L.F.	$ 6.00	$ 420
12-Inch Flap Gates	2	Ea.	$ 600.00	$ 1,200

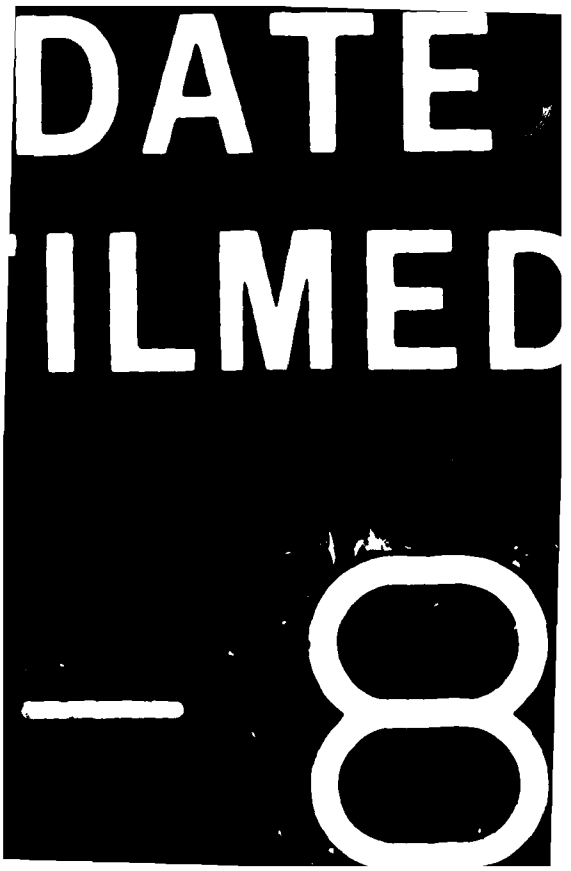
Total This Page - $2,121,600

TABLE E6 (Contd.)

CONSTRUCTION COST ESTIMATE

FEDERAL COSTS FOR FLOODWAY, MODIFIED, AND DIVERSION CHANNELS

Description	Quantity	Unit	Unit Price	Amount
Road Pavement				
(a) Subgrade	2,000	S.Y.	$ 1.00	$ 2,000
(b) 11-1/2-Inch Subbase	2,300	S.Y.	$ 4.00	$ 9,200
(c) 4-1/2-Inch Bituminous Concrete Base	1,900	S.Y.	$ 7.00	$ 13,300
(d) 2-Inch Bituminous Concrete Surface	1,850	S.Y.	$ 5.00	$ 9,250
(e) Stabilizer Shoulder	320	S.Y.	$ 5.00	$ 1,600
Shotcrete				
(a) Mobilization and Demobilization	-	Job	L.S.	$ 4,000
(b) Cement Mixture	400	Bag	$ 80.00	$ 32,000
(c) Welded Wire Fabric	2,200	Lbs.	$ 1.50	$ 3,300
Seeding	25	Acre	$1,200.00	$ 30,000
Support System, West 25th Street Bridge Pier	-	Job	L.S.	$ 90,000
Landscaping	-	Job	L.S.	$ 5,000
Zoo Entrance Gate	-	Job	L.S.	$ 500
			Total This Page	$ 200,150
			Total Page E21	3,681,475
			Total Page E22	2,121,600
			Total	$6,003,225
			Contingencies (15%)	900,775
				$6,904,000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